

19 OCTOBER

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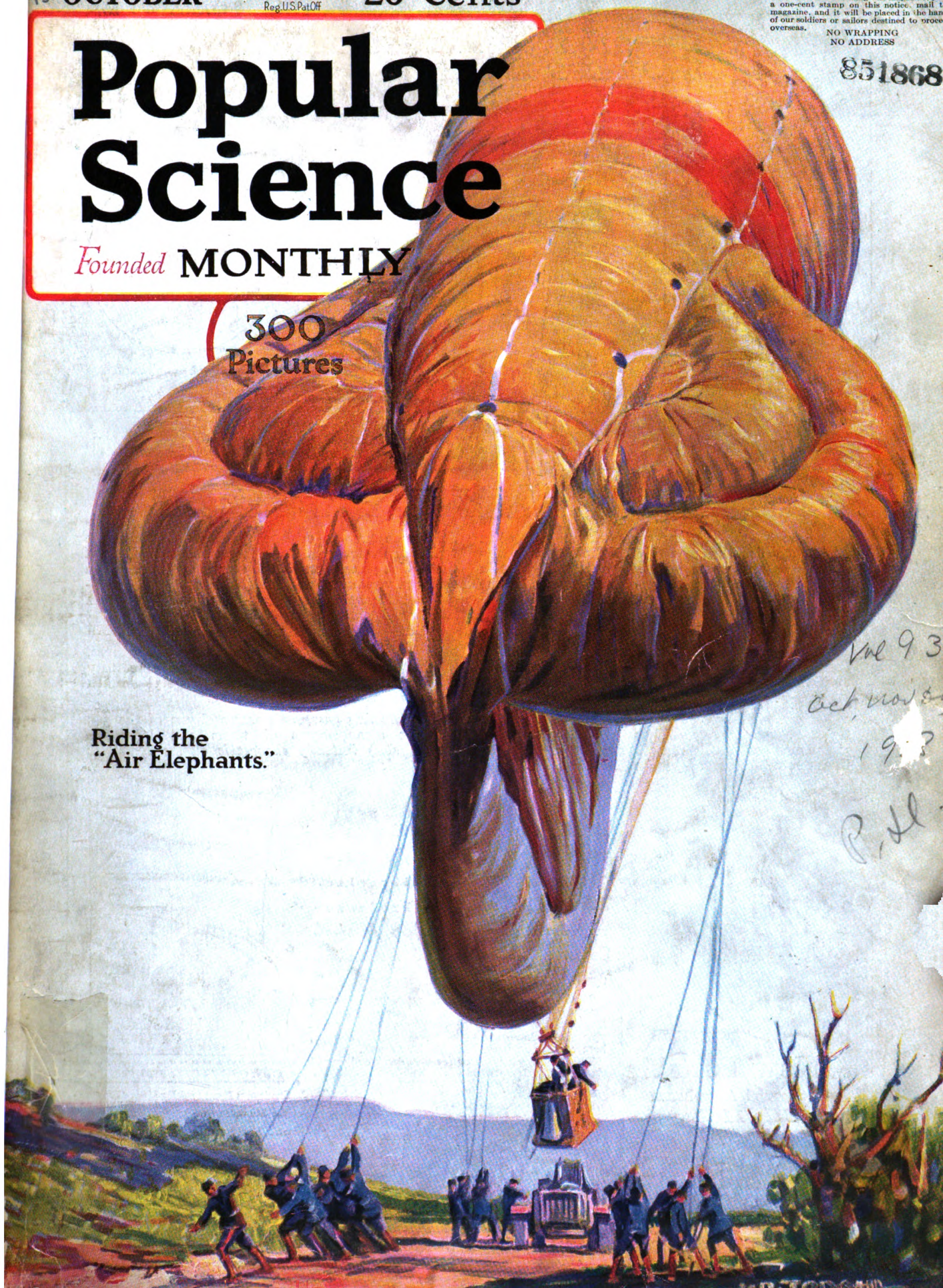
Popular Science

Founded MONTHLY

300
Pictures

Riding the
"Air Elephants."

Vol 9 3
Oct, Nov &
1913
P. 11



*He used it at Princeton
He uses it now.*

...fully digested. The president will confess that he wrote the peace message on his little typewriter. He sent it over to Robert Lansing, secretary of state, on Sunday of the fateful week that followed. Mr. Lansing examined the neat script of the Hammond and imprinted a few of his own characteristic pencil marks, taking into his confidence none but himself. Directly after making a few notes, and being examined the neat script of the few



Type
Changed
Instantly
Any Language
Any Style

"Just Turn the Knob."

President Wilson and His Multiplex Hammond

While at Princeton, President Wilson used a Hammond. Later, as Governor of New Jersey—and now, at the White House, he still uses it—*personally!*

The newspaper clipping above shows that when President Wilson has something of the utmost importance—he writes it *personally* on his Multiplex Hammond. And the letter below shows what he thinks of his Multiplex Hammond.

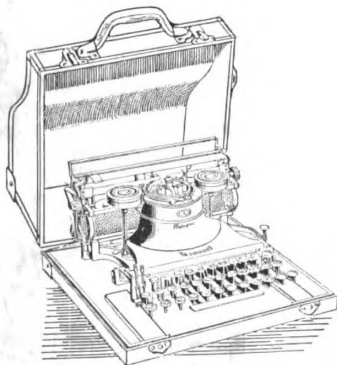
The Multiplex Hammond does everything any other typewriter will do—and *besides*, if you "Just Turn the Knob," you can change your type from Elite to Italics, or your language from English to Spanish—even Greek or Russian, Etc., Etc.

The Hammond possesses a different style of type for every possible purpose. Write a letter in the large Gothic style; a few *seconds* later you may make notes in your memo book in Miniature Roman type. You change from one to the other by "Just Turning the Knob."

It is so easy to operate the Multiplex, and the touch is so velvety, that you forget everything, except that which you are writing or creating. It brings you ease and versatility, and thus *brings out your personality*. No matter how fast you think, Multiplex Hammond will get your thoughts.

Every Multiplex Hammond "Writing Machine" carries two different styles of type, or two languages, in the one machine. There are more than fifty different languages in many sizes and styles which can be substituted in a few seconds.

The following paragraph shows eleven of the 365 different arrangements of types and languages (actual size) *instantly changeable on the Multiplex Hammond:*



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Condensed Aluminum
Only 11 lbs.

Full Capacity

Many Typewriters in One

Write for Special Folder

Special Prices to

Officers of the Army and Navy

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Tell us what your business or vocation is and we will give you *free*, full details of the particular Multiplex Hammond that is best adapted to your needs.

Our new folder, "The Miracle of the Multiplex," fully explains the many things the Multiplex does that cannot be done on any other typewriter. It will be sent to you, free. Also the Booklet, "The President and His Typewriter." Write for them *now*—sign and mail the Coupon, and mail to—

Hammond Typewriter Co.

639 East 69th St., at East River, New York City

In reply to your letter of ...
...I beg to acknowledge the terms upon
...which you would exchange this machine, which is
...a Hammond No. 17,707, for a new Hammond, ideal
...key-board. I have done most of my literary
...work on this machine and would not exchange it
...for any other make.
Very truly yours,
Woodrow Wilson

Read the
above letter
from
**WOODROW
WILSON**

CUT OFF ALONG DOTTED LINE

Gentlemen: Please send Booklets, "The President and His Typewriter," and "The Miracle of the Multiplex," to

Name.....

Address.....

Occupation.....

Inquire about special terms to professionals

Test Phonographs This Way

Before You Decide Which One You Want

Does It Play All Records?

Or does it require you to limit your selection to its own make? Do you want to own a phonograph which will keep you from hearing *all* your favorites?

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The Ultona is a new conception, not an attachment nor makeshift. It is a universal player, instantly adaptable to any make of record.

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What About Tone?

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The Brunswick Amplifier is molded of holly-wood, in a shape demanded by acoustic laws.

Thus tone is given every opportunity to expand. Wood gives the proper vibration which a casting can not.

And so the Brunswick Method of Reproduction, heralded as the most advanced of all, brings new tonal values, new standards.

One must hear The Brunswick to appreciate its superiority. Your ear will be

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Does The Brunswick Cost More?

No. In spite of its overwhelming advantages, the price is comparable with those lacking Brunswick ideas. Model for model, The Brunswick has been kept at the usual prices. Yet it could easily command more.

This instrument is made by the House of Brunswick; a leader for 73 years in the wood-working art. We have long maintained a nation-wide organization, with branches and dealers everywhere.

And so the cost of distribution is lessened. Thus we can afford to offer a super-phonograph at ordinary prices.

Where Can I Hear The Brunswick?

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This will not put you under the slightest obligation to buy. We want you to make comparisons. You will then appreciate The Brunswick betterments.

Go now and hear this new-day instrument. Then decide if you could be happy with another.



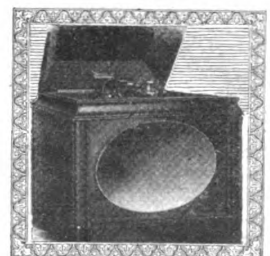
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'Way off in Lake County, Illinois, young Frank Johnson, the son of James Patrick, the son of Gramper Thomas, was down in front of the tavern, at the edge of the little lake, getting the **BOATS** shipshape against the impending swoop of duck-hunters. Row-boats, motor-boats, house-boats—and tubs. Lots of them. All needed soaking up and some caulking a bit, and cleaning, and a certain amount of launching, of course. And painting—but only for the sake of Art, or for identification when abandoned by irresponsibles at distant points around the lakes.

Well, we've bought this space in this ponderous publication merely to report that when Henry Monksommers, Jr., took a hitch in his very early bathing suit, and asked what kind of wood all those boats were mostly made of, Frank, he up and said, "Why, **CYPRESS, OF COURSE!** Whadja s'pose?" So Henry never forgot it. And no more will you, though you never shall build a boat as long as you live.

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Science

October

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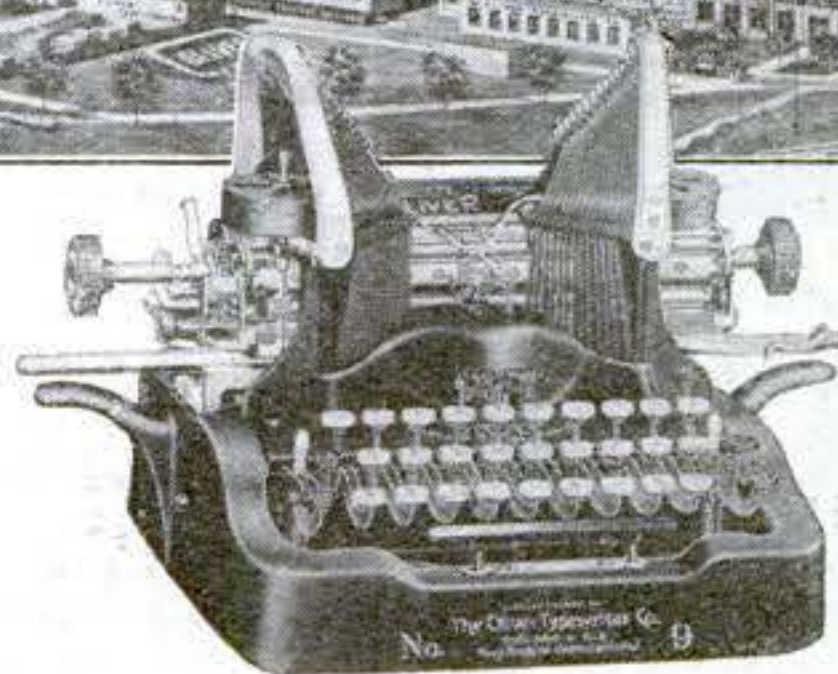
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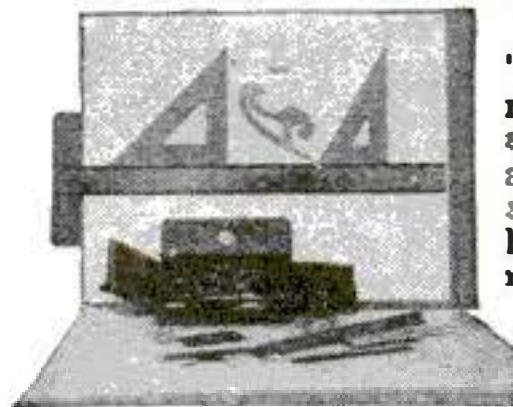
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An Important Letter From the President of the American Commerce Association

Not Enough Men for These \$5000-A-Year Positions!

CHICAGO, ILL., SEPTEMBER, 1918.

I am writing this letter as a last resort to see if we cannot secure more men willing to qualify for positions paying \$2,500 to \$10,000 a year—positions in which a man can save his employer that amount every month, perhaps every week.

These positions are open in a field that is new and as yet unthought of by most men. It is difficult for the average man, until he knows the facts, to understand why so many of these positions are begging for men needed, so I am going to tell you a few of the facts.

Transportation is today the second largest, and the most important business in the country. More than two billion dollars annually are spent in freight rates, yet it has been estimated that 8 out of every 10 shippers are losing money on shipments. This is because few men know the most economical methods of forwarding merchandise.

There are about 40 million different rate combinations in the United States. When you stop to think that there may be 25,000 different kinds of goods shipped between about 30,000 shipping points on one or more of the 26 different kinds of rates and subject to some of the 43 different special freight services, the problem seems to be very intricate. But this work is just like any other work—it is easy for men who are specially trained. Those who have a technical knowledge of the Government Freight Rate System can easily determine the legal rate, which may apply on any particular shipment—he can tell whether a rate is the *cheapest* rate in existence, whether a slight alteration in packing will cut the rate in half and so on.

How important is the trained traffic man's work can be seen by these few cases out of thousands which occur every day.]

A concern in South Chicago had been shipping about 200 cars of Coke from Connellsville to their smelters. Some time ago a traffic expert succeeded in getting a rate adjustment which resulted in a saving of about \$5.00 on each car. Thus, on this one item alone a saving of over \$300,000 a year was effected.

In St. Louis, through misrouting of freight, errors in reconsigning cars and undercharges on shipments, a railroad lost over \$27,000.

A traffic expert discovered that freight rates paid by the Meeker Coal Co. were legal, but exorbitant. A ruling secured from the Interstate Commission resulted in a refund of \$122,000.

An oil shipper in Kansas was losing over \$30 every day—\$700 monthly—because he did not know of certain tariff regulations entitling him to lower rates.

Tens of thousands of concerns, without realizing it,

are losing fortunes every year because they do not know that there are countless classifications, special freight services and rate combinations which legally entitle them to rates that would amaze them if they but knew.

There are about 50,000 large business corporations and about 400,000 smaller shippers which must be protected by competent traffic men. These concerns have freight expenses running from a few thousand dollars to many thousands of dollars monthly. Yet in the entire country there are only a few hundred men actually competent to save the money now being wasted through lack of efficiency in applying the Government Freight Rate System. It is estimated that over 100,000 more traffic experts are needed at once.

Heretofore, there has been no simple way to master the details of traffic management. Realizing the crying demand for trained traffic experts, and seeking relief, the American Commerce Association—a National organization OF traffic men, FOR traffic men, BY traffic men, offers to give men the training required to make them competent to handle the problems of most economical distribution. The instruction is given by mail and can be studied in spare time, at home. Though the most complete and thorough training is given, the Course is remarkably easy to master, and through the Association costs but a few cents a day.

Through its Advisory Council, every member of the American Commerce Association received the help of such men as T. Albert Gantt, traffic manager Montgomery, Ward & Co.; Wm. Scott Cowie, general eastern freight agent Erie R. R.; Samuel G. Lutz, general traffic manager Chicago & Alton R. R.; Chas. E. Mayer, traffic manager Stone & Webster Engineering Corporation; A. C. Westfall, traffic manager Cadillac Motor Car Co.; T. T. Harkrader, traffic manager American Tobacco Co.; D. E. Gelatt, assistant general freight agent New York Central R. R.; as well as nearly 200 others of equal prominence.

It is impossible to go into details in this letter, but the Association has published a remarkable book for free distribution which explains everything in detail and tells how anyone may quickly learn the new profession of traffic management. The possibilities in this field today—great as they are—are nothing compared to what they will be a year from now. If you are at all interested in getting into this highly profitable field, paying salaries of \$2,500 to \$10,000 and more, be fair to yourself and write for the remarkable book now offered free by the Association. In writing, please state whether you are a beginner or whether you have had previous traffic experience, and give your present age and occupation. Address, American Commerce Association, Dept. 910, 206 S. Wabash Ave., Chicago, Ill. (American Commerce Building.)

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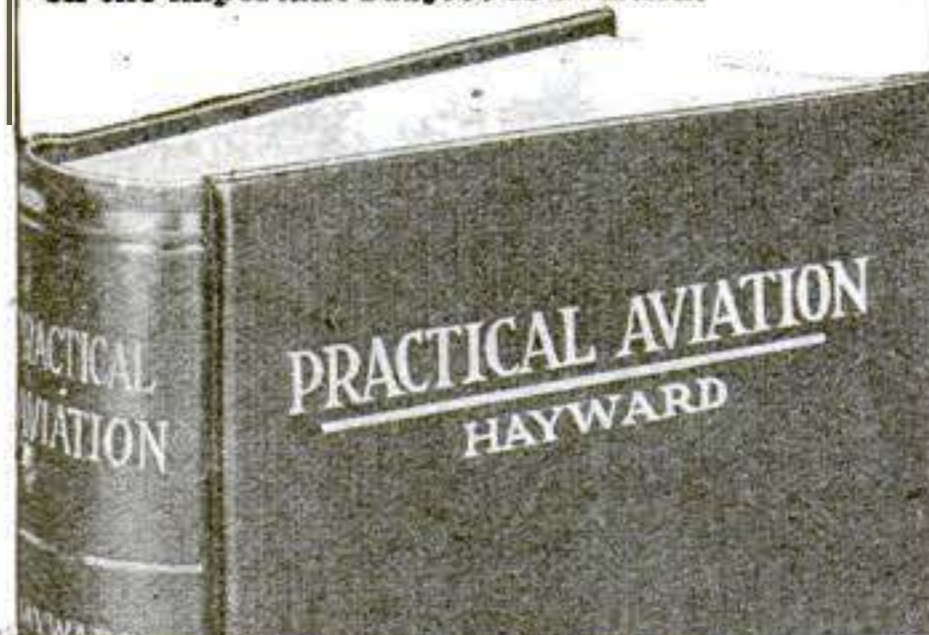
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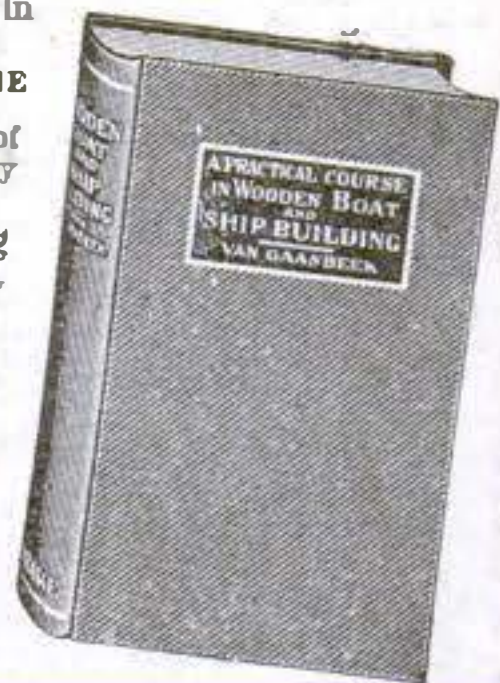


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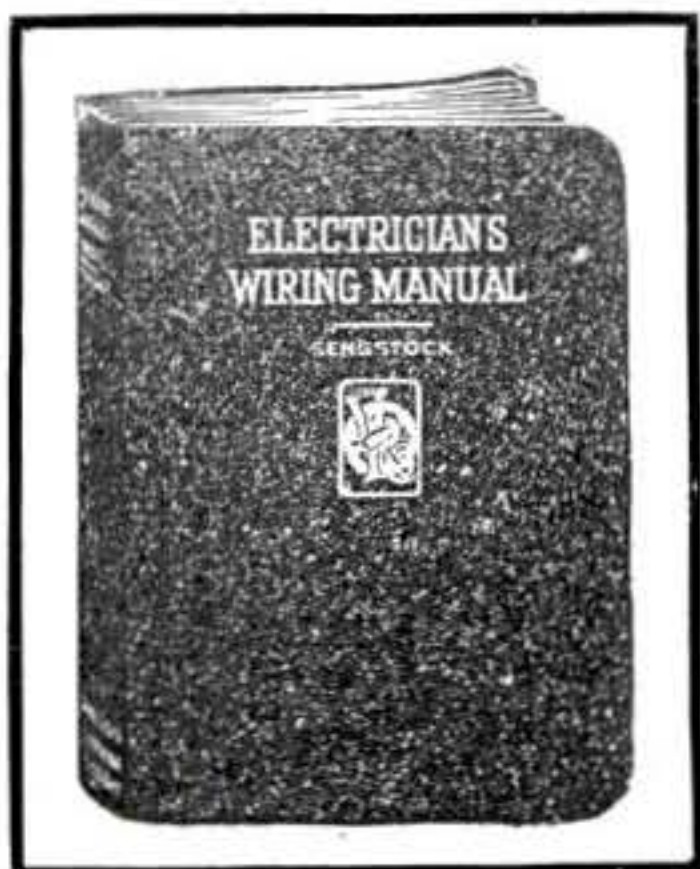
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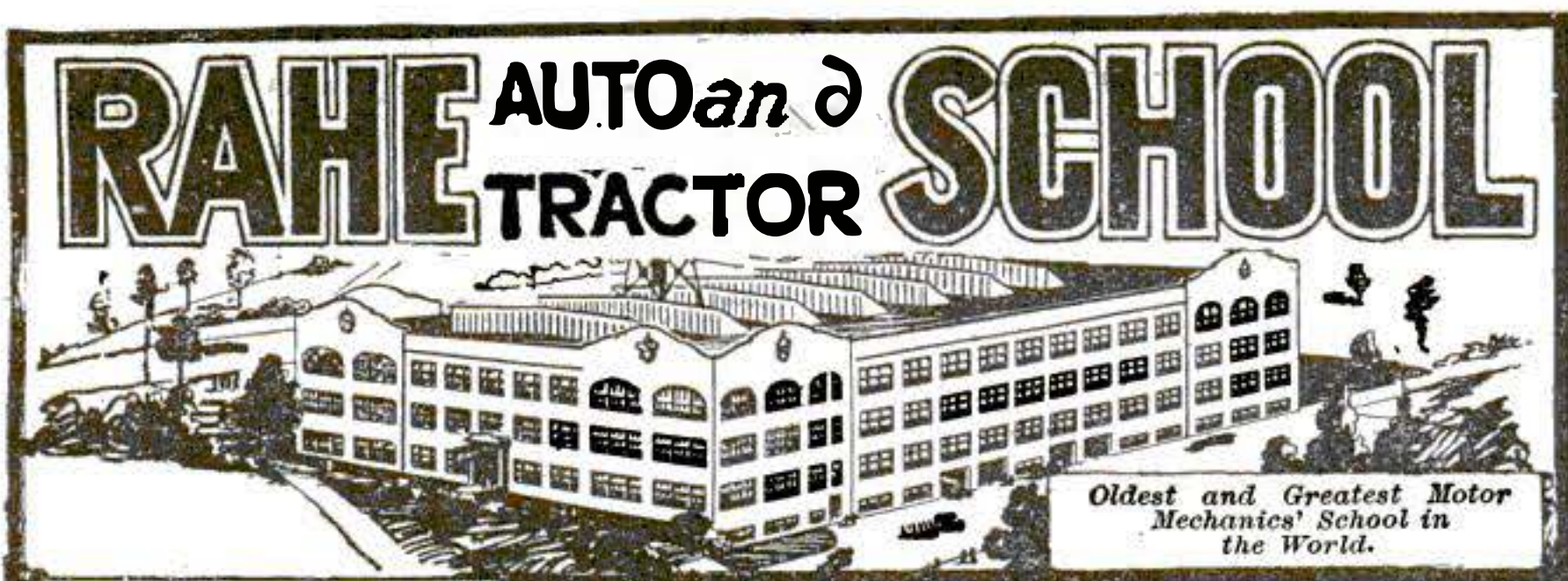
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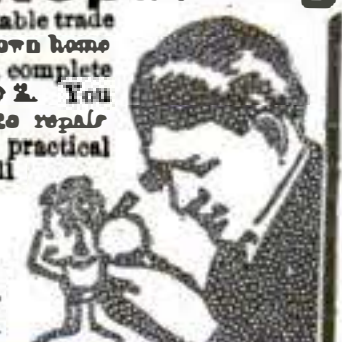
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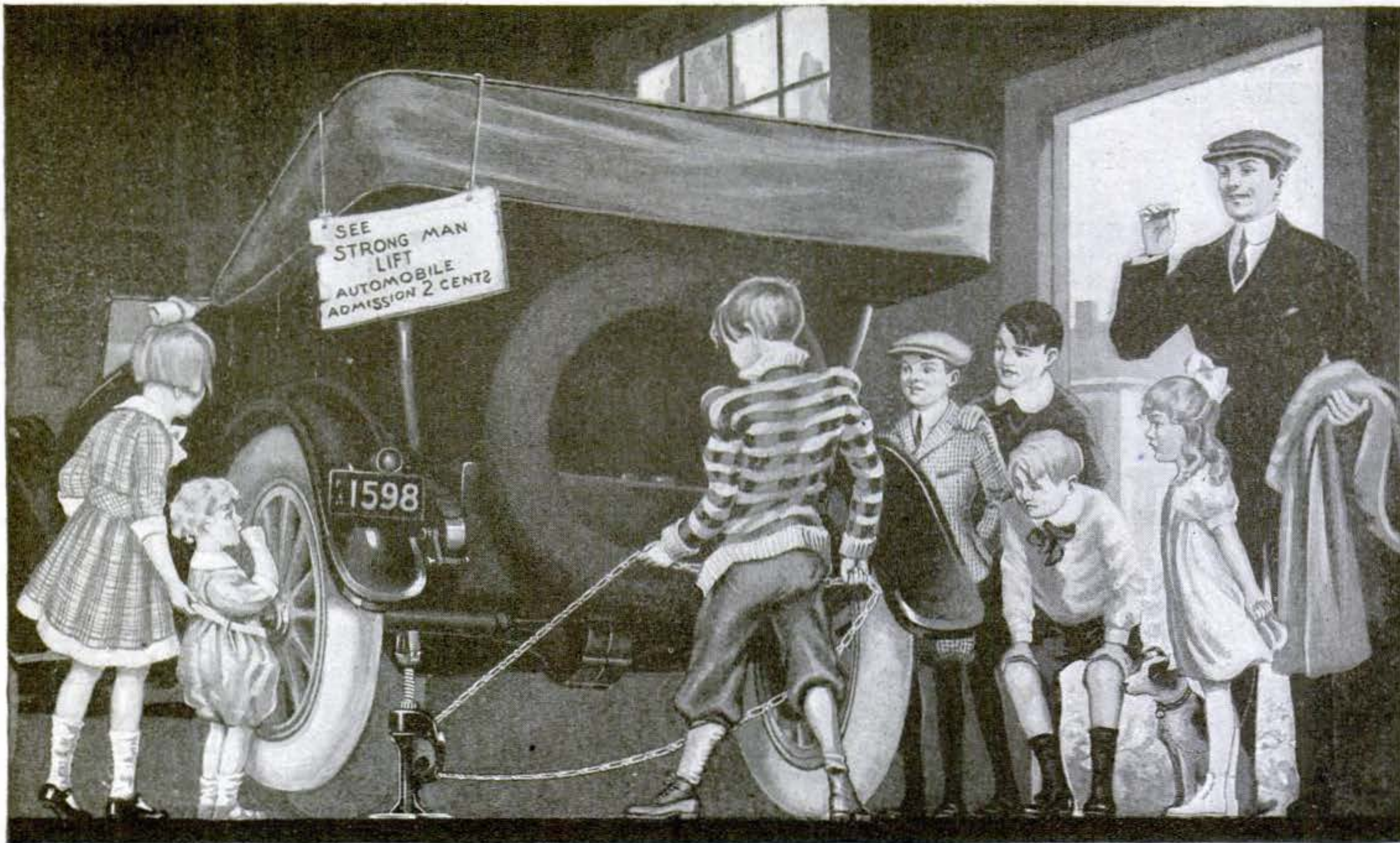
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Weed Chain-Jack

To lift a car with the Weed Chain-Jack, simply give a few easy pulls on its endless chain while you stand erect—clear from springs, tire carriers and other projections. *To lower a car* pull the chain in opposite direction.

10 Days' Trial

If your dealer does not have them, send \$7.50 for any size for passenger cars, or \$15.00 for the Truck size, and we will send you one, all charges prepaid. For delivery in Canada send \$8.50 for any size for passenger cars or \$16.00 for the Truck size. Try it 10 days. If not satisfied, return it to us and we will refund your money.

MADE IN FOUR SIZES

Size	Height When Lowered	Height When Raised	Height When Raised With Aux. Step Up	Price
8 inch	8 inches	12½ inches	14½ inches	\$ 7.50
10 inch	10 inches	15½ inches	17½ inches	7.50
12 inch	12 inches	18½ inches	No Aux. Step	7.50
12 in. Truck	12 inches	19½ inches	No Aux. Step	15.00

The 8 inch and 10 inch sizes are made with an auxiliary step as illustrated. When in operative position this step adds two inches to the height of the jack.



The Jack That Saves Your Back

**AMERICAN
CHAIN COMPANY, Inc.**
Bridgeport, Connecticut.

In Canada—DOMINION CHAIN CO., Ltd., Niagara Falls, Ontario.

LARGEST CHAIN MANUFACTURERS IN THE WORLD

Popular Science Monthly

Waldemar Kaempffert, *Editor*

October, 1918
Vol. 93, No. 4

Twenty Cents
\$2.00 a Year



Fitting Shoes to Fighters

Machine Puts \$100,000,000
Worth on the Right Feet



To be certain that the measuring device this soldier is holding has made no mistake, one of the steel pieces in the apron-like holder is placed in the shoe when testing for length

IF men are going to get anywhere on their own feet, the value of the feet depends upon how well they are shod. The problem, therefore, of fitting shoes properly to the feet of an army is of fundamental importance. One hundred million dollars' worth of shoes ordered by the War Department is testimony to the magnitude of the work.

Mr. E. J. Bliss and his staff, of Boston, attacked the mechanical end of the problem with such success that four men measured eleven hundred soldiers in one day. The technique of testing and delivery has been so systematized that six men with one inspector have been able to furnish the shoes as fast as the measurements were made.

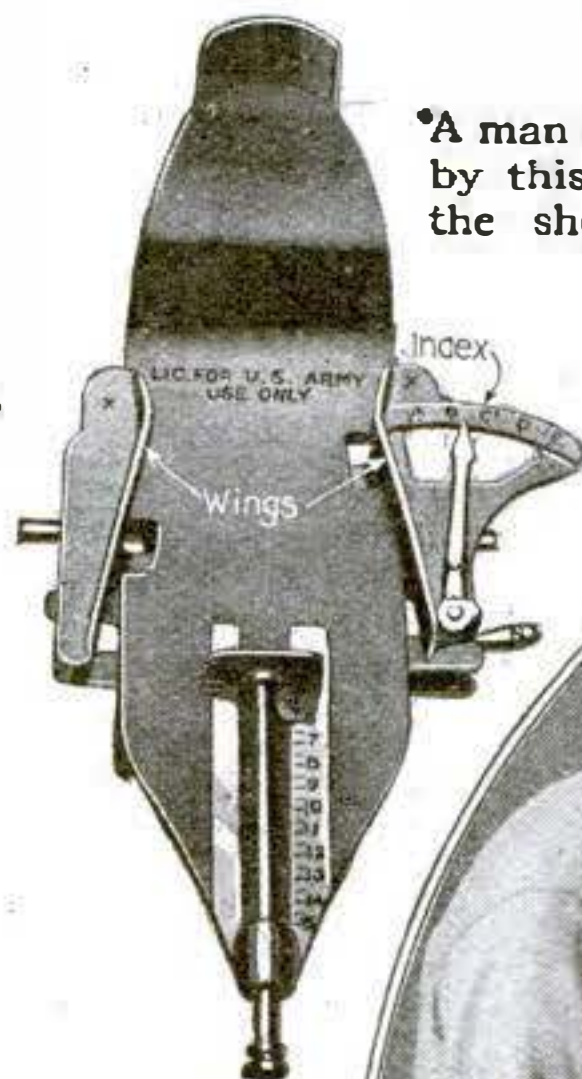
As a patriotic duty the Bliss inventions have been given to the Government for use during the war. With the new measuring devices, a soldier can in a single minute have the size and width of both feet determined; in one or two more he can receive the shoes from the stock; and inside of five or six he can have finished the trying-on and trying-out exercises, and go forth to his duties properly shod.

The foot-measuring machine that makes this possible is very simple. It is a heavy metal foot-form with an adjustable toe-piece to give the length or size, and wings that will measure the width. The heel of the form is raised to low-heel height above the sole, and is furnished at the back with a metal heel-guard.

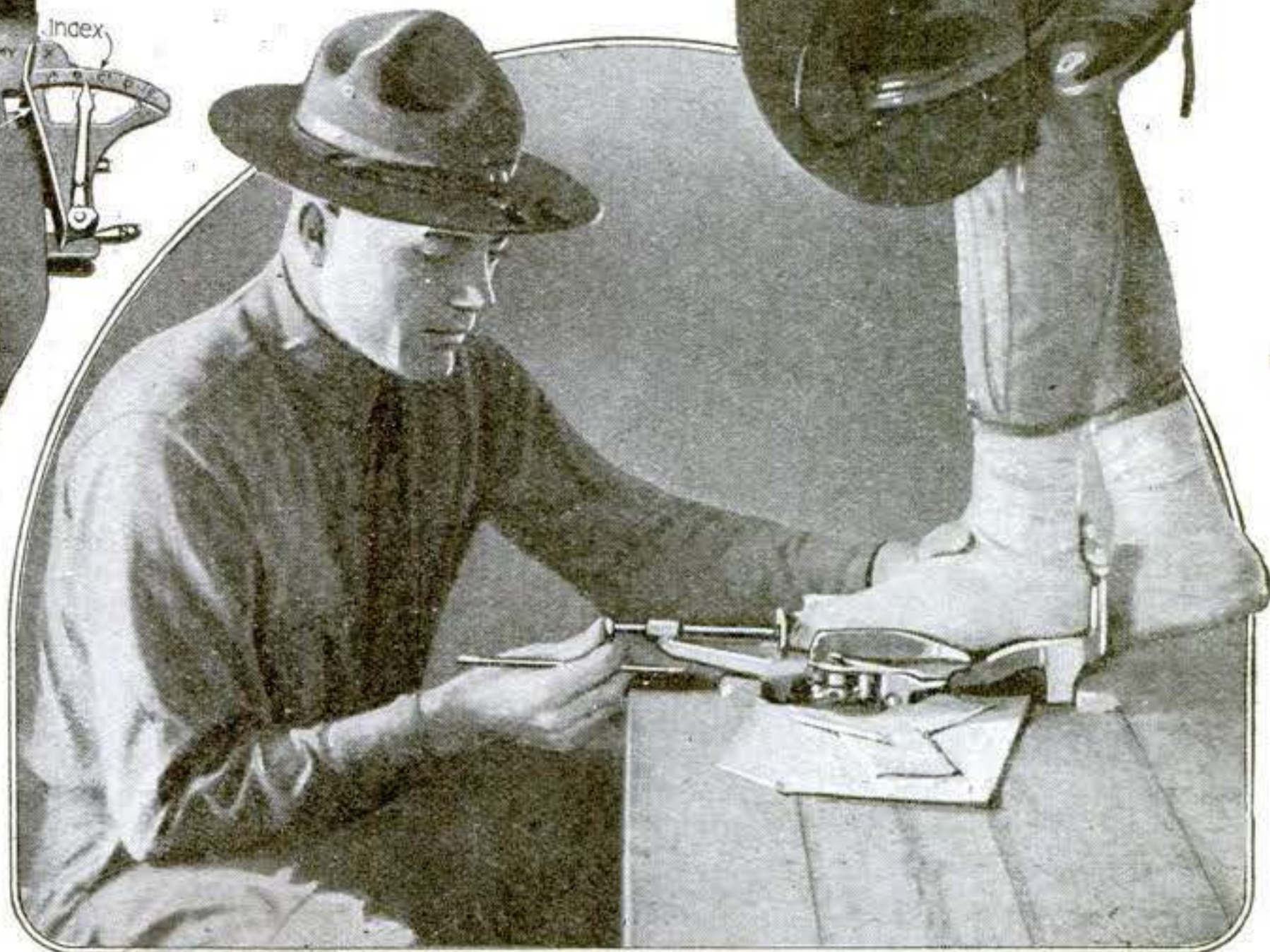
The stocking-footed soldier steps upon the form with his heel against the guard, and the

size that he requires is shown instantly by the adjustable toe-piece. Next, he throws the weight of his body upon the ball of the toe by raising his heel a little; thereupon the wings spring into place, and on an index scale the proper width is indicated. With a ticket showing the size, the soldier goes to the stock-keeper, receives the shoes, puts them on, and goes through the required exercises. A man a minute goes forth.

For the quick testing of the fit of a shoe, an accessory device has been invented—a small, solid bowl with a long flexible handle—which, inserted in the shoe during the trying-out process, takes up the slack allowed between the foot and shoe at the toe.



*A man a minute can be fitted by this little machine—and the shoe never pinches



Most men in civil life wear misfit shoes: this soldier will have a fit that no custom cobbler can beat

Published at 225 West Thirty-ninth Street, New York City



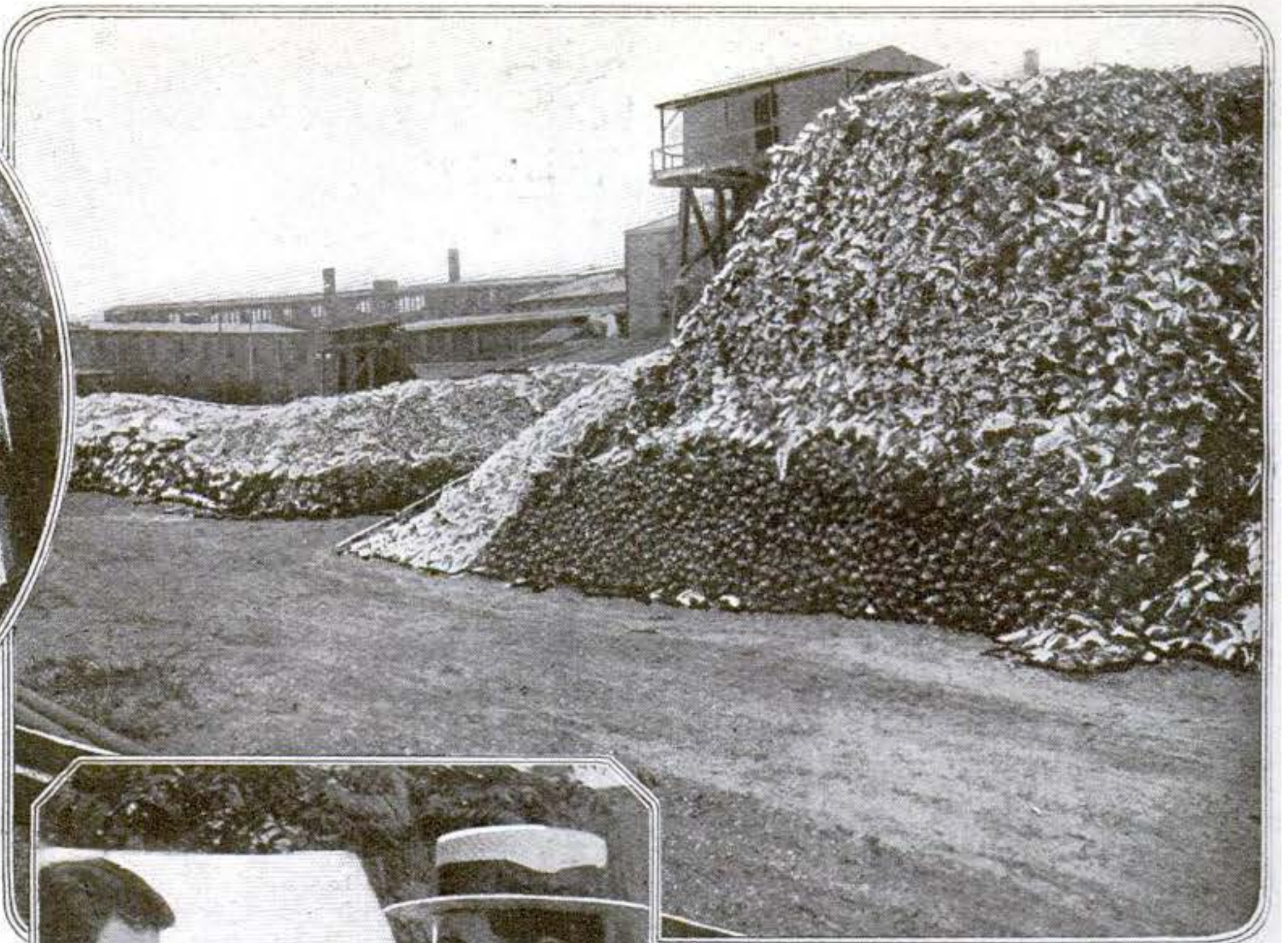
Jonah Would Have Liked This

IT looks like a huge wishbone, but in reality this arched entrance to a passageway in Gibraltar is made of the jaw-bones of a whale. If we had it in the United States, it might serve as a monument to vanished greatness; for, where 680 vessels sailed from our ports in 1840 in search of whales, only 32 put forth in 1914—in spite of the fact that whale oil is rich in glycerine, which is used in making explosives.

Not on the Level

THIS is Crazy Town, otherwise Himley, England. The houses lean in every direction at drunken angles, and nothing appears as it really is. The man in the doorway appears to lean, but it's the house that is off the vertical. It is one of the most uncanny houses in an uncanny village. It has sunk at one end and not at the other.

What's the explanation? The town is in the coal country. The coal has been worked out from underneath, often close to the surface. The ground has settled over the old galleries, and a leaning town is the result.



New Life from Death

THIS mountain of skulls and thigh-bones was once a familiar sight on the salt meadows of the Passaic River in New Jersey. Human bones are rich in phosphorus and valuable mineral salts of all kinds, and therefore valuable as agricultural aids. They had been brought from Algiers, where a great bone deposit was formed years ago when dead victims of the plague were thrown over a cliff. The bones were purchased by a fertilizer company. Thus death in the Old World helped to bring forth life in the New. But residents near this bone factory objected so strongly that the traffic was abandoned.

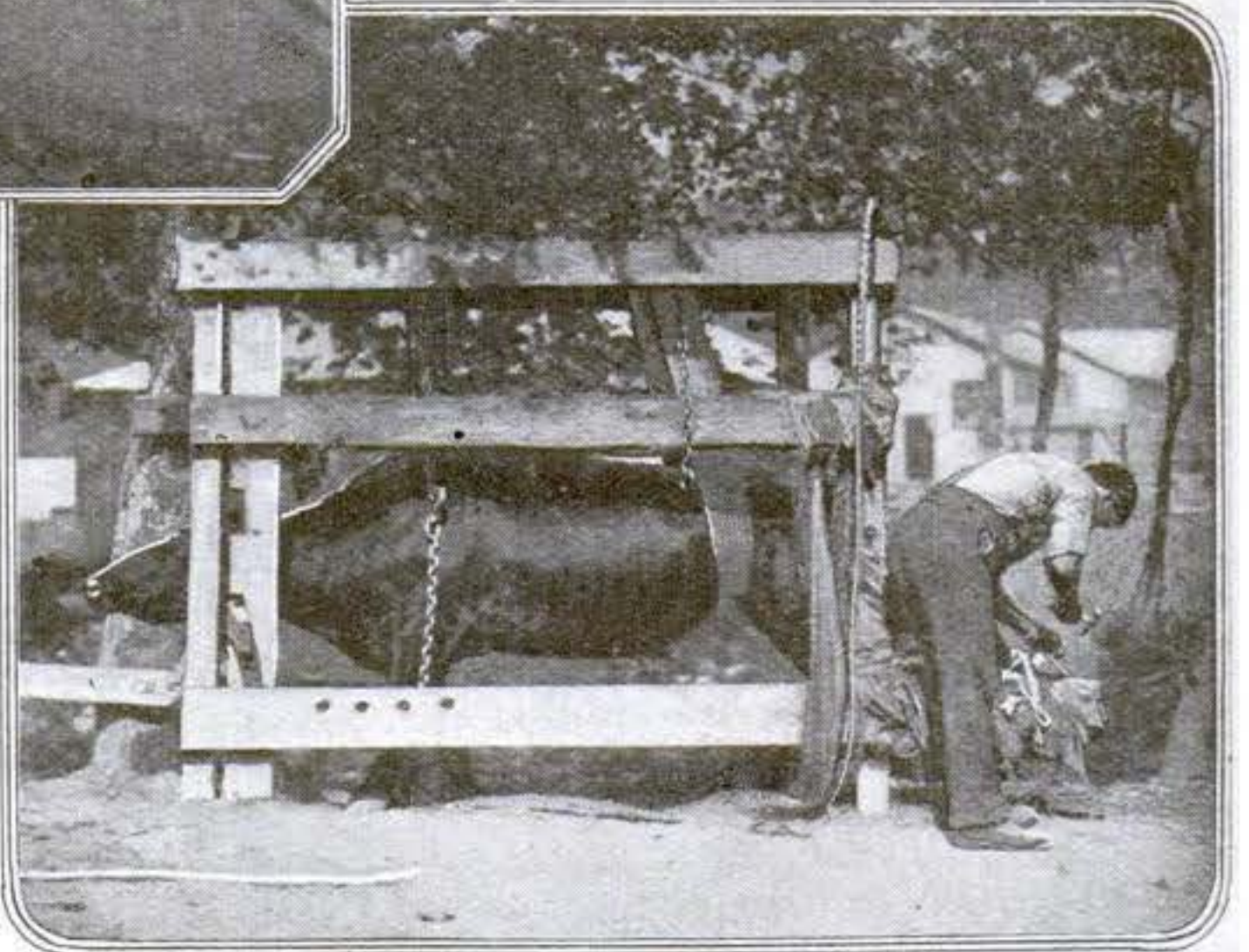


Have You Been Tattooed?

THEY do it by machinery now, and promise that it won't hurt. That's what the painless dentist says, but with the electrical tattooer performance keeps pace with promise. All you feel as the needles—there are six of them—etch a design on your skin is a slight tingling sensation.

The machine consists of two electromagnets, operating on the principle of an electric vibrator, used in connection with a needle-bar. The bar has one needle-point for outlining work and six to put in the shading. Operating through an ink-tube, the needles force the fluid through the tiny punctures they make in the skin.

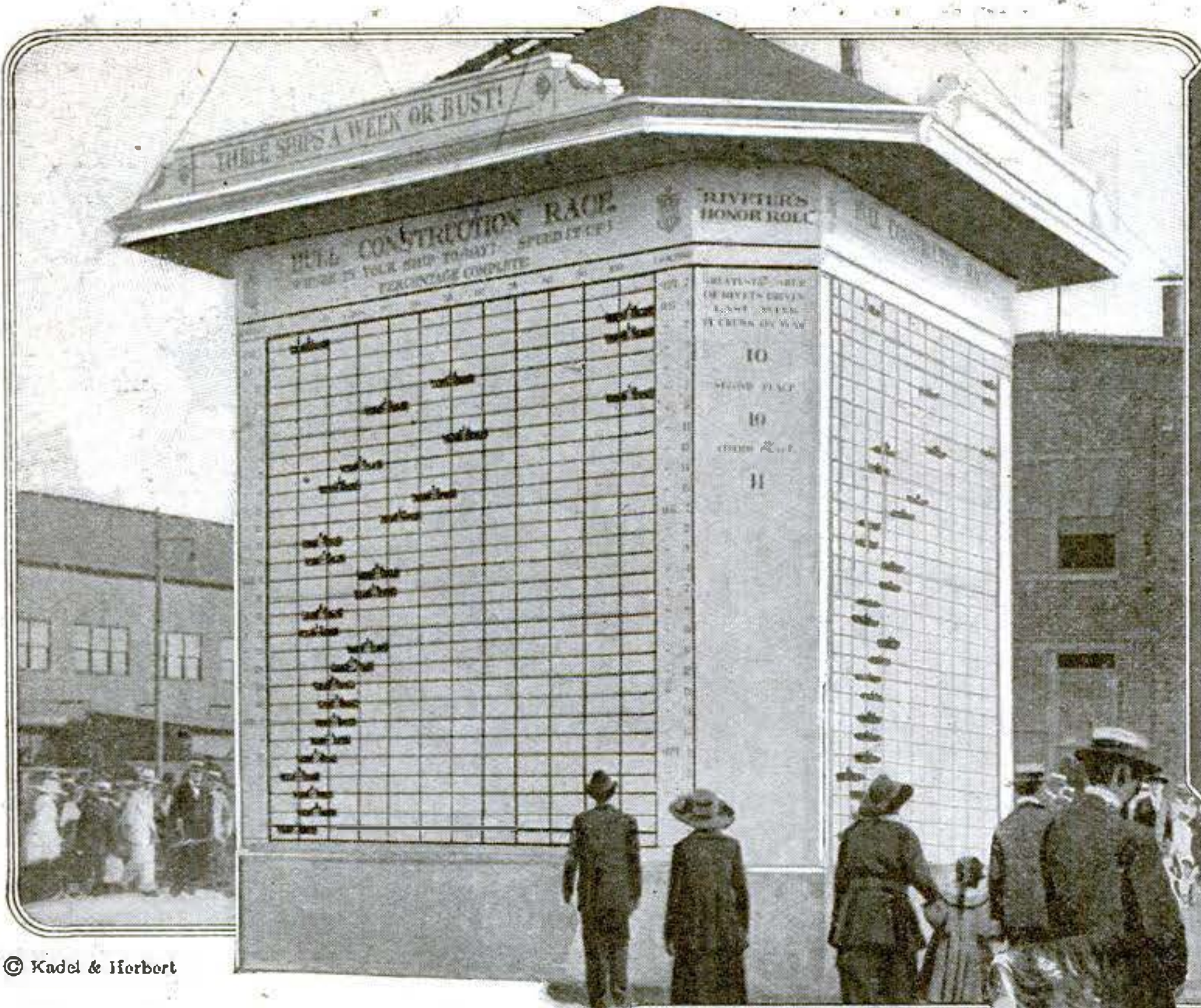
The growth of tattooing as a fad is apparently responsible for the introduction of the machine-made pictures on a human background. The manufacturers of the apparatus speak of "the pleasant profession" of those who operate the machine. So an electric tattooer is a "professor" as well as an artist, and perhaps some day we may be invited to an exhibition of realistic nudes. Meantime, so the manufacturers say, fortune awaits the artist-professor who is master of the machine.



Getting One on the Ox

IN parts of the South the ox is still a problem to the back-country traffic expert. The blacksmith knows that when the ox puts his foot down on anything he's very firm about it, and that a swat from the heavy tail would floor Willard for the count. One of the best devices for avoiding any such catastrophe is shown above.

The head of the animal is firmly held in a stanchion, while with a broad band-and-chain hoist the beast's hind quarters are lifted until the kicking zone is limited to nothing. Then, with one of the animal's legs comfortably placed on a padding of old bags and lashed in place, the ox-shoer can get to work with an easy mind.



© Kadel & Isorbert

Three Ships a Week or Bust!

IT must have been the baseball score-board that inspired the manager of the Newark Bay Shipyards to suggest: "Let's visualize the work; let's see the ships moving along on the score-board."

An elaborate structure was erected to show the daily progress. "Three Ships a Week or Bust!" is the motto beneath which are details of the hull construction race and the speeds of the riveters.



There's a Fortune in His Skin

THE most tattooed man in the world is Jack H. G. Gould, sometime a soldier in the United States Army. He is a whole picture gallery in himself. Look at his back, here. He paid Filipinos, Hawaiians, and Americans to tattoo him. From his neck to the soles of his feet, Jack is adorned with Virgin Marys, mermaids, snakes, fishes, stars, arabesques, dragons, and butterflies. He has virtually spent a fortune on his skin. Why did he have it done? Well, why do people have their ears punched for ear-rings, or squeeze a number six foot into a number four shoe?



© Underwood and Underwood

With One Arm He Fiddles

A HUNGARIAN baron who was an enthusiastic pianist late in life lost his right arm. Was he daunted? Not much. He arranged the sextette from "Lucia" for the left hand. The task of the man in our picture was even harder; yet his mechanism for bowing gives him the flexibility of a Kreisler.

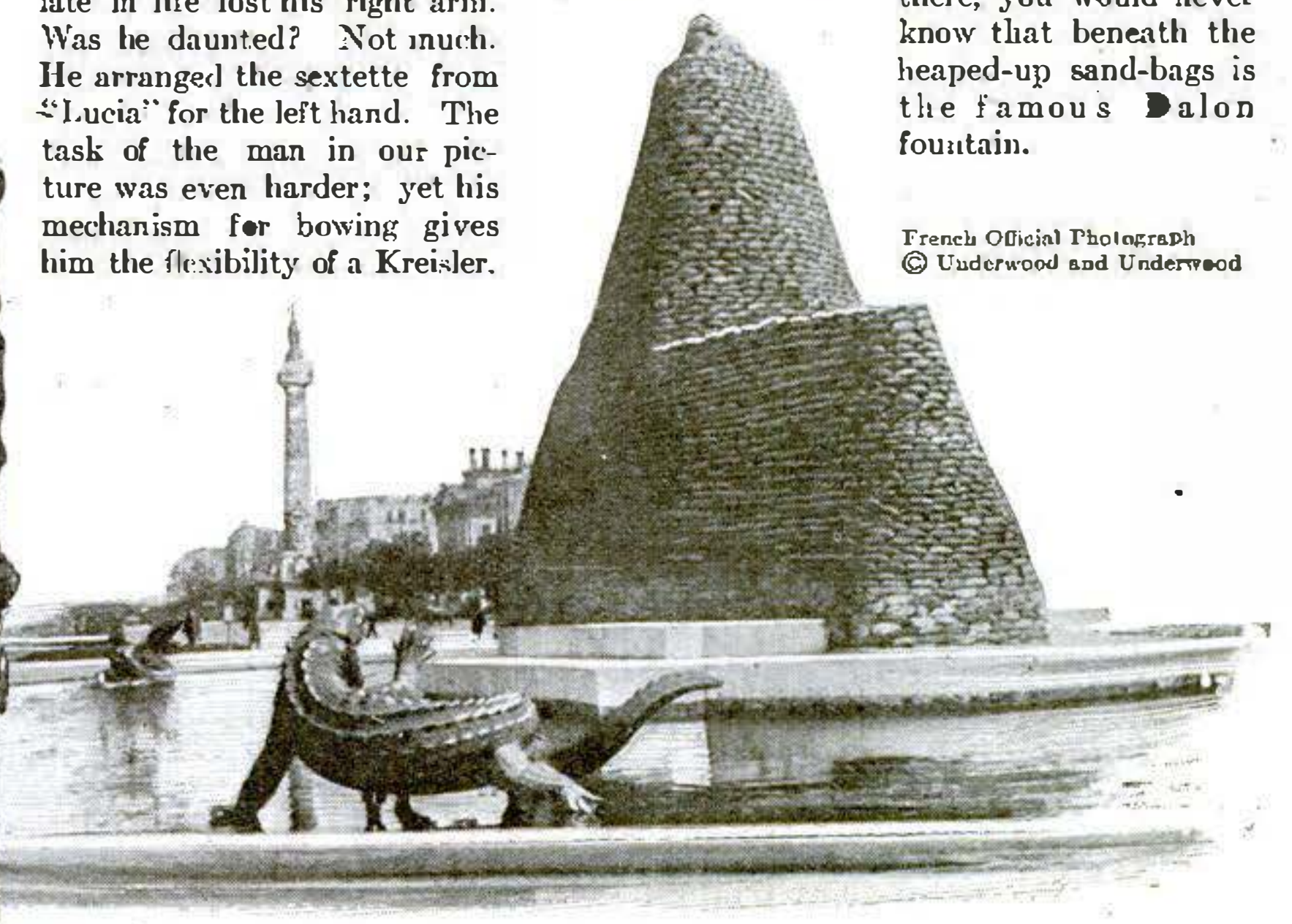


He Does It with His Jack-knife

LIKE many a Connecticut Yankee, George W. Lockwood, of Stamford, is a whittler. He used to whittle to assist his conversation; now he whittles and does no talking. This wooden chain is one of his masterpieces.

A Little Light Goes a Long Way in France

THIS latest Paris fashion in mirrors is not designed to help ladies to keep their hats on straight. The circle of small concave reflectors on the street posts are arranged to catch all stray beams of light that are about in a city darkened against air raids. M. Charron, the engineer who introduced these mirrors, is now planning to illuminate street signs likewise.

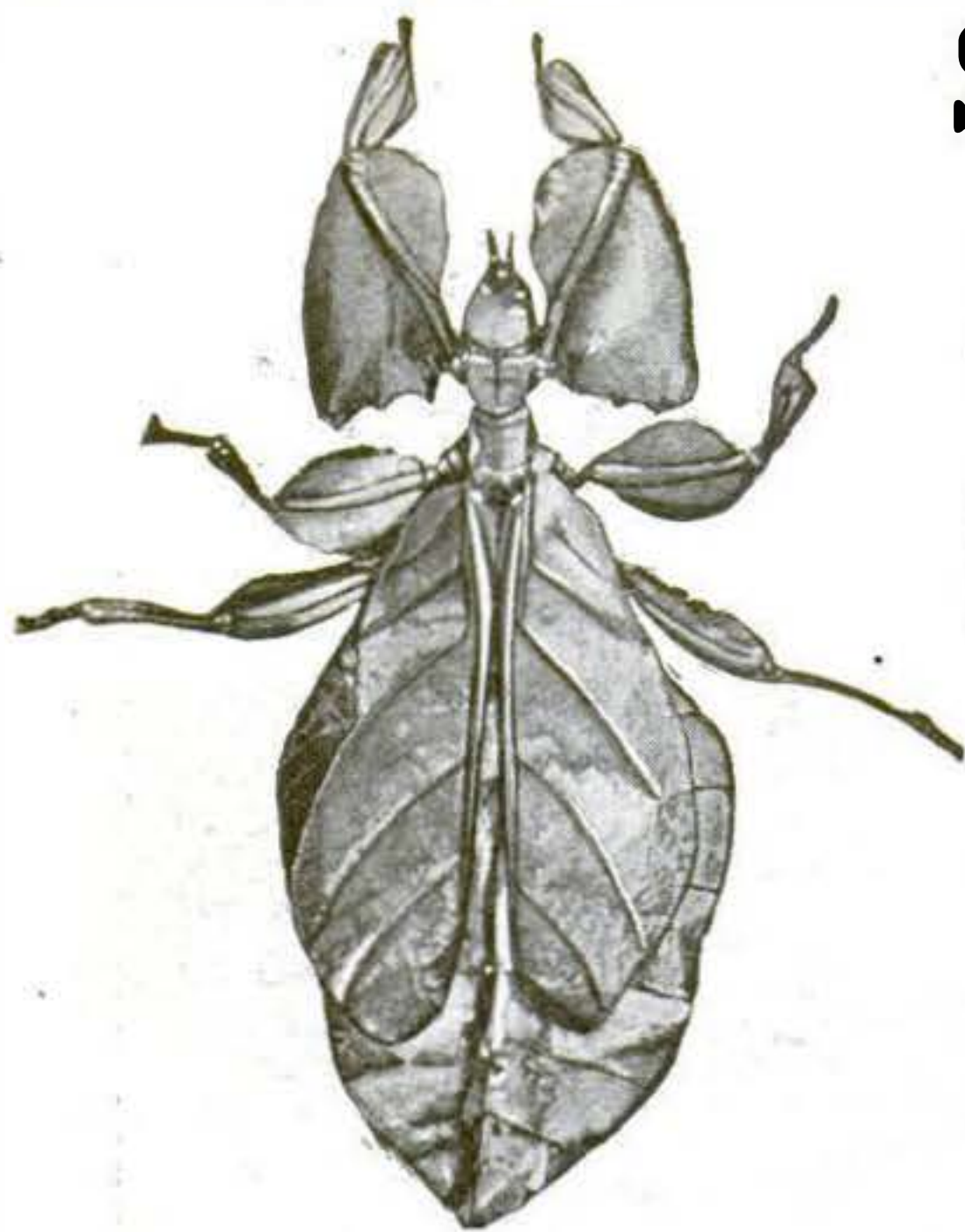


French Official Photograph
© Underwood and Underwood

She Did It First

Camouflage? Why, Nature invented it ages and ages ago!

Left and right: In nature's perpetual war the weak protect themselves from the strong by camouflage—mimicry, as the naturalist calls it. It's easy to see why the Indian "walking-leaf" is so called

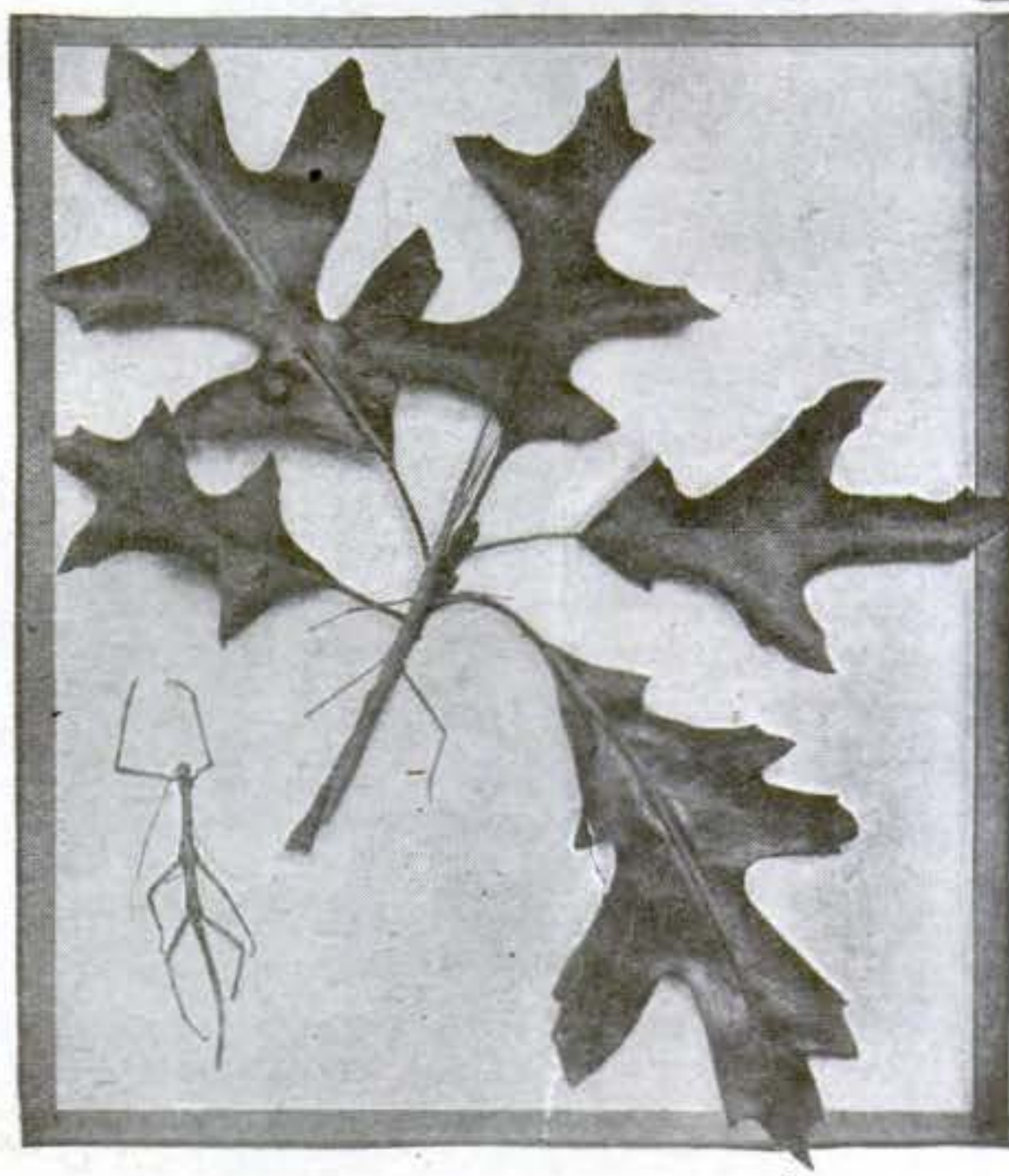
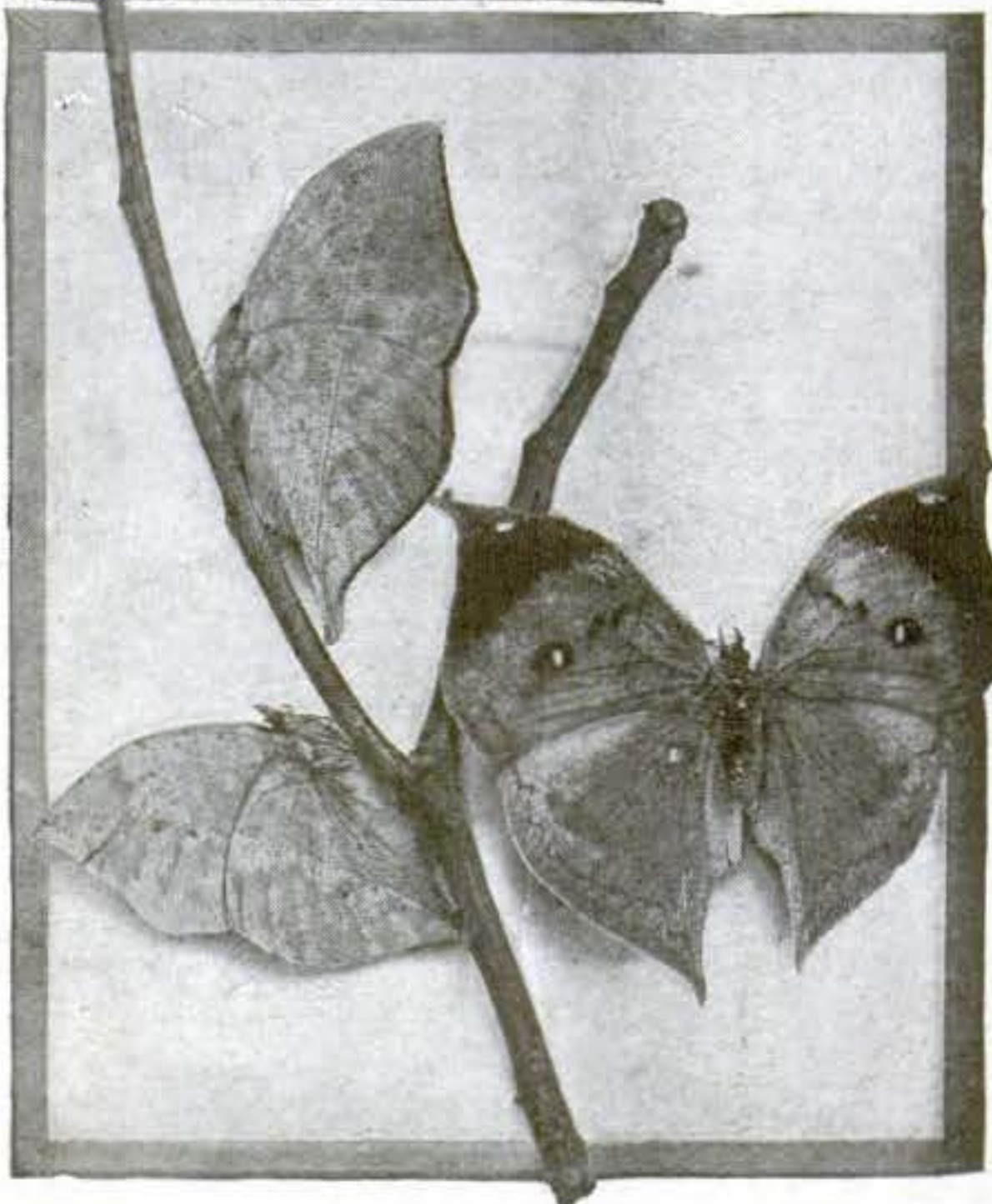
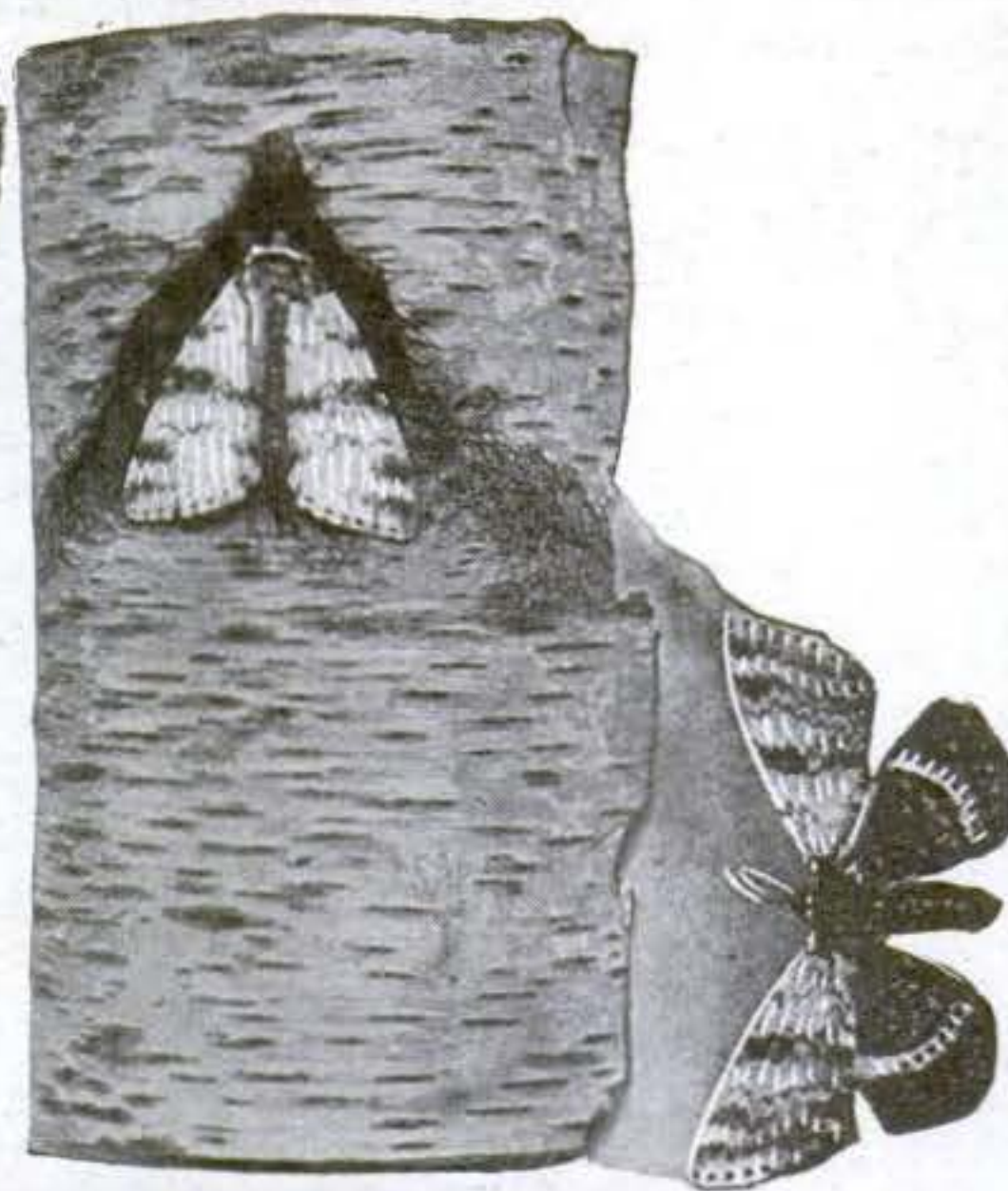


Below: Only to the most practised eye is it possible to detect the "yellow underwing" when it clings to a rough-barked tree

Below: The American Catocala moth has two sets of wings. When the rear wings are folded under the forward wings, it can hardly be distinguished from birch bark



Above. At the left: To avoid capture, the "mourning-cloak" butterfly lies flat against the trunk of a similarly colored tree. At the right: The disguise of the common caterpillar is perfect. Even its legs are fringed to mimic the moss on which it crawls

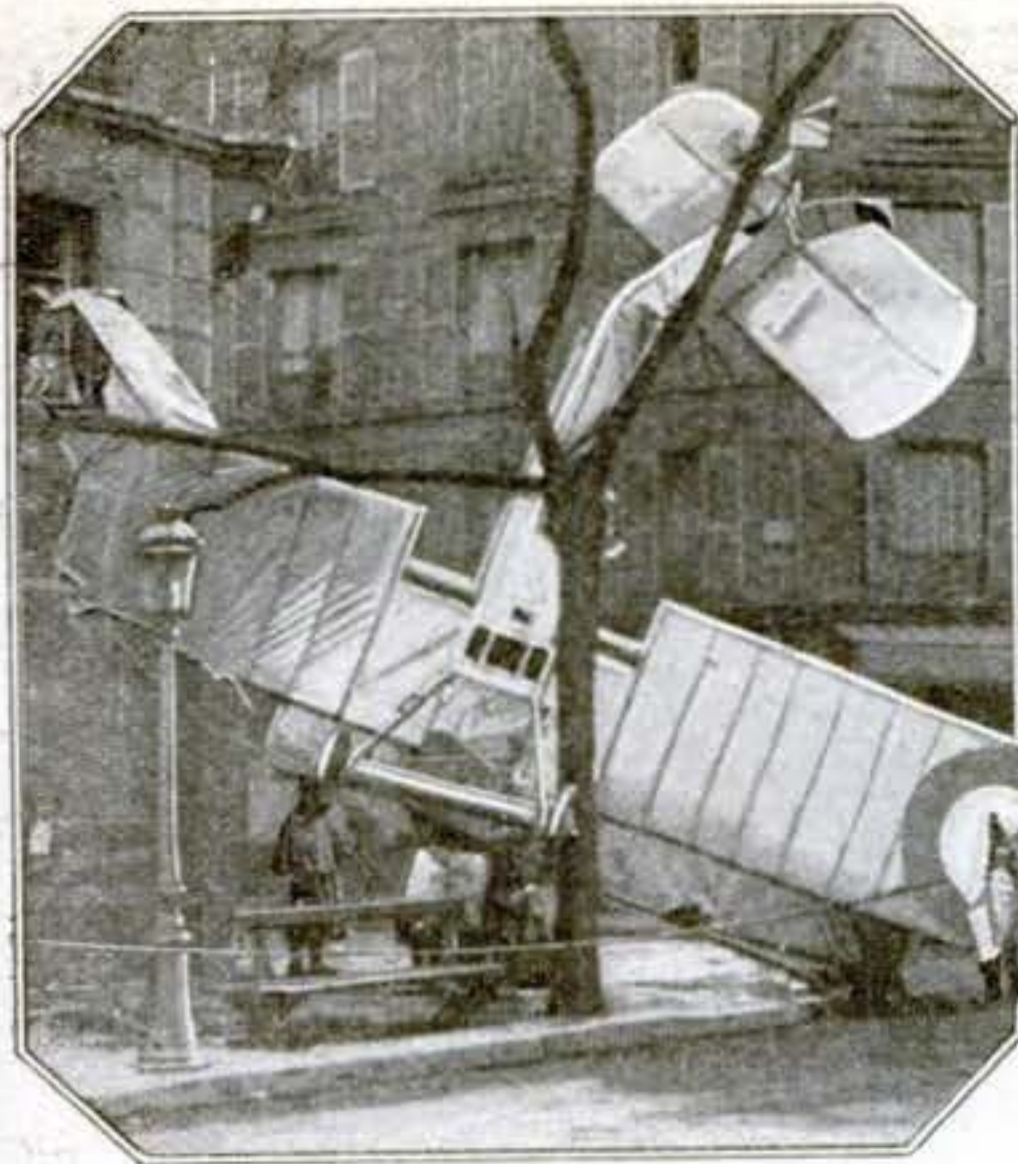


Is it any wonder that Alfred Russell Wallace, trained naturalist though he was, could not find an Indian kallima that had escaped his net?

The "walking-stick" looks so much like a spray of twigs that it must actually be touched to convince oneself that it is alive

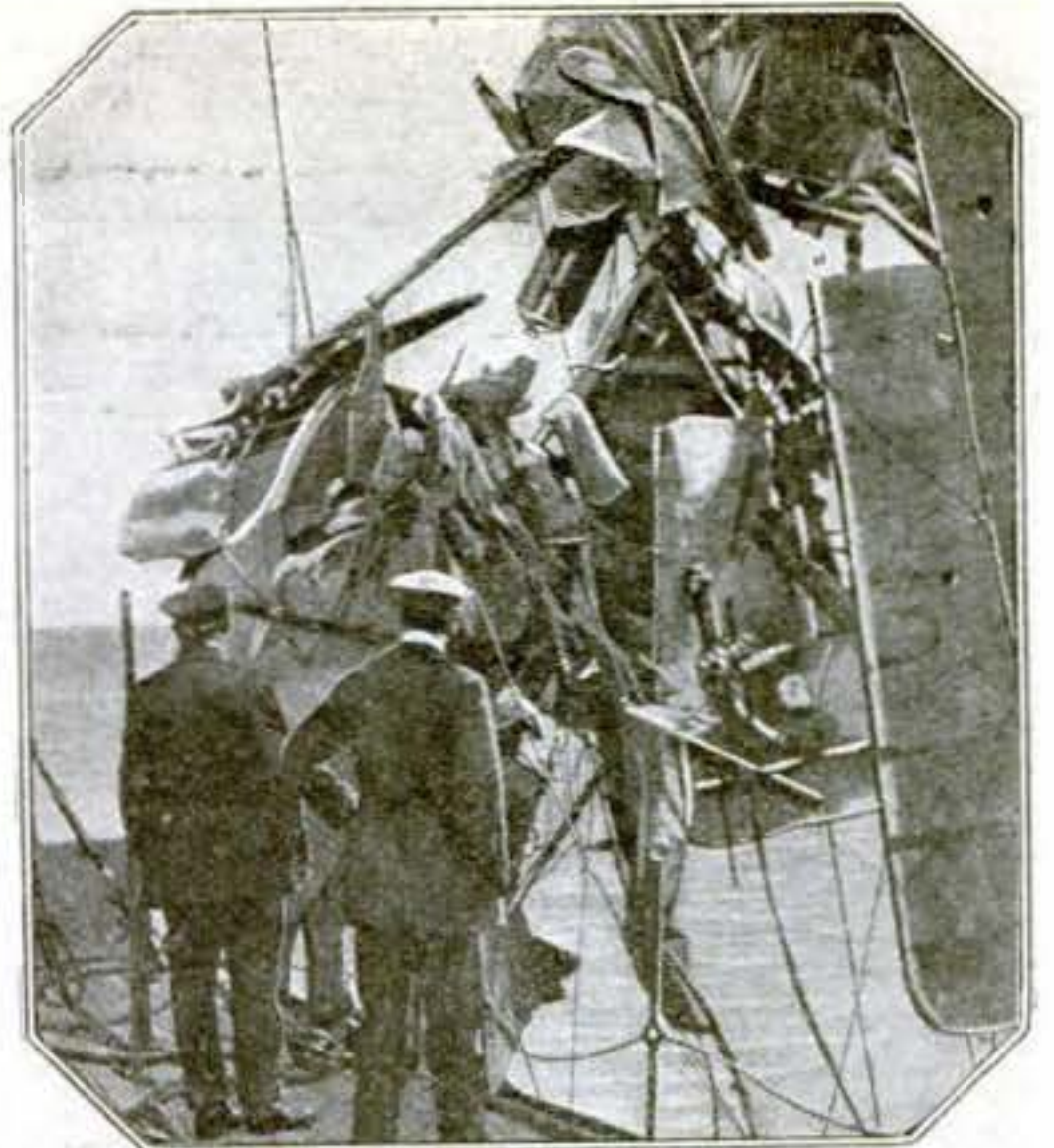
What Goes Up Must Come Down

*But the new Airplanes
often survive the crash*



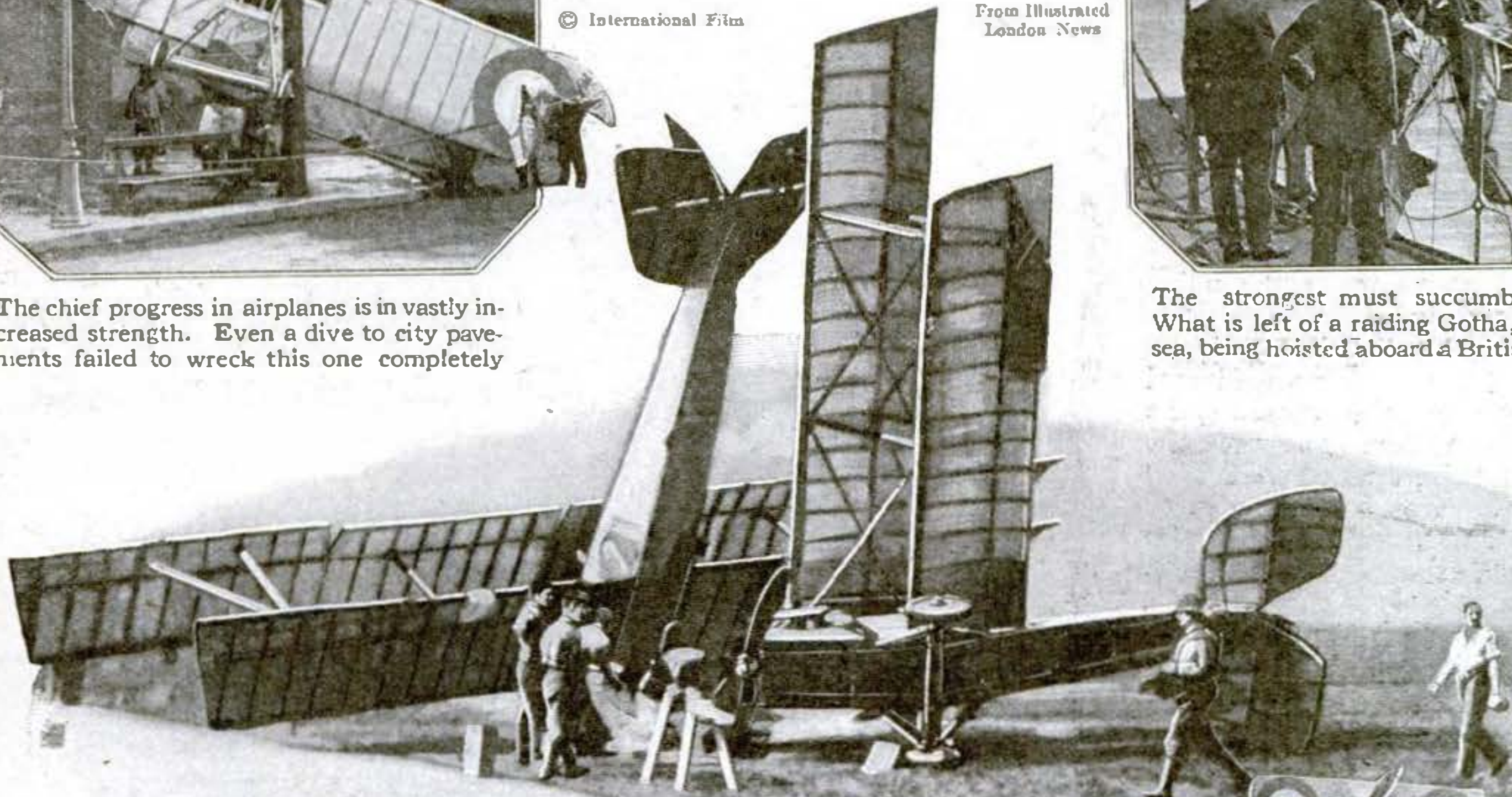
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From Illustrated
London News



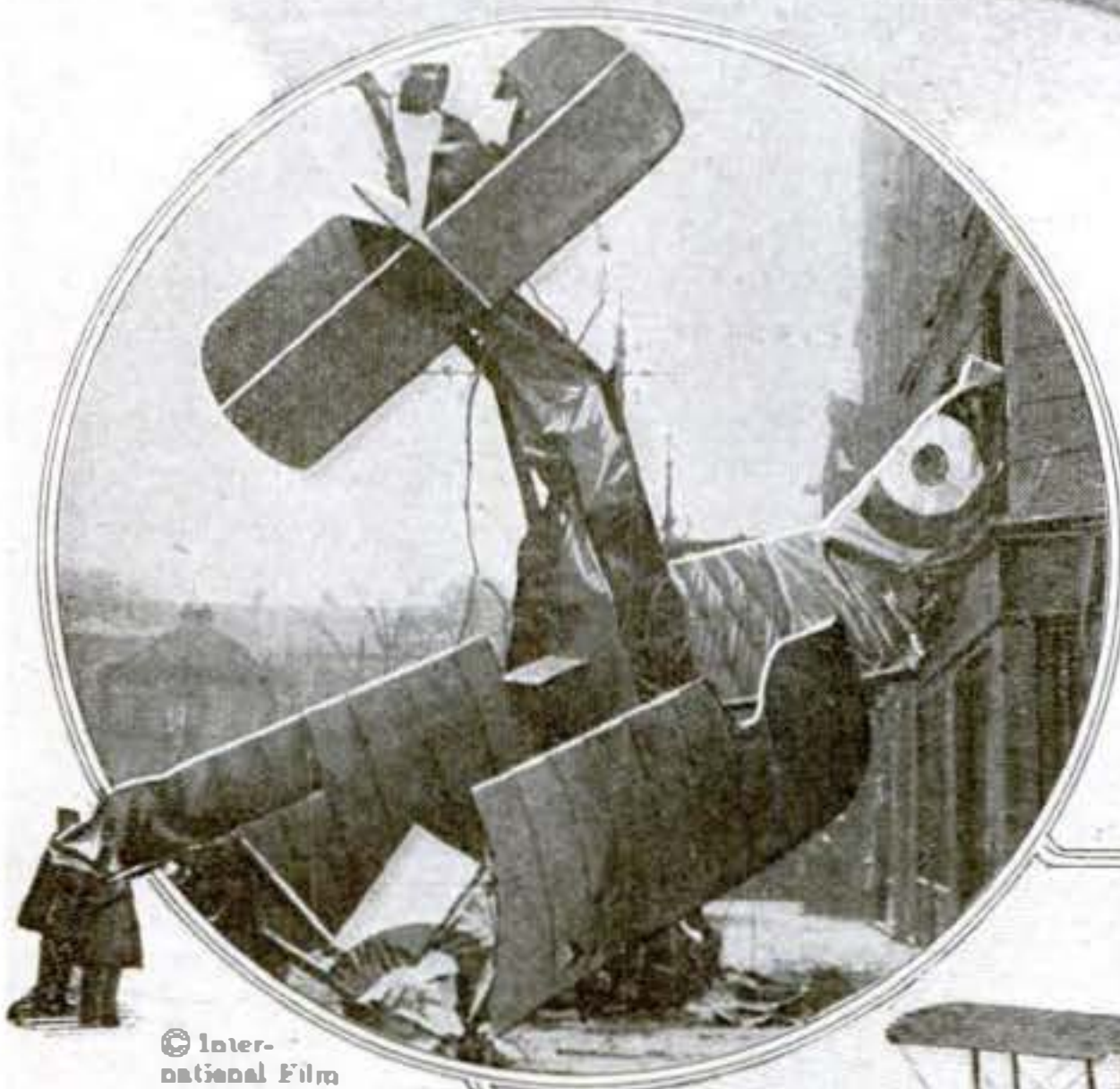
The strongest must succumb to shell-fire. What is left of a raiding Gotha, shot down at sea, being hoisted aboard a British salvage ship

The chief progress in airplanes is in vastly increased strength. Even a dive to city pavements failed to wreck this one completely

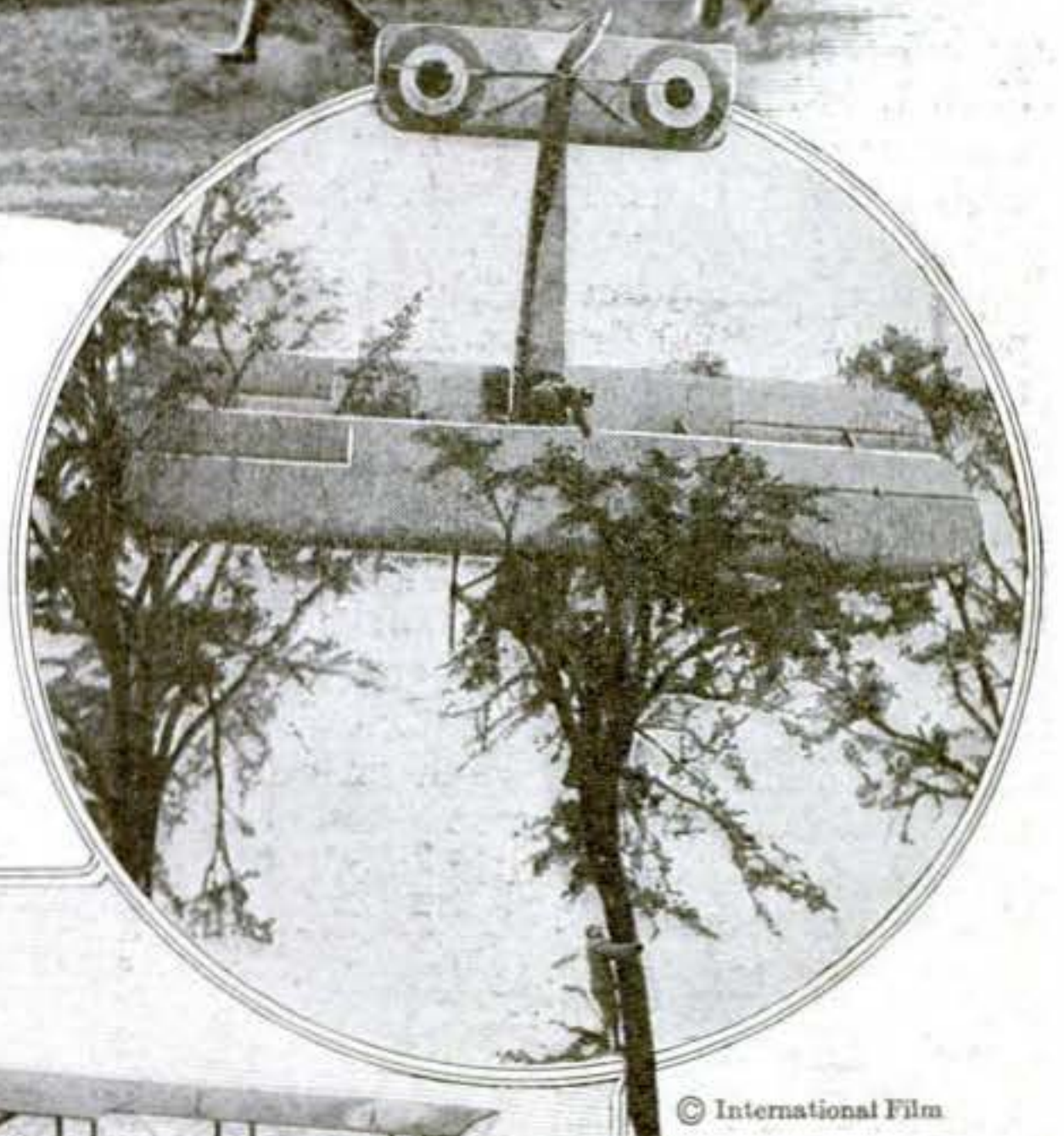


They met in the air, and fell locked together. But the pilots were not hurt, and the machines suffered less injury than trains crashing together on the solid earth

Not an ideal landing platform, by any means; but the machine was little hurt, and the aviator not at all. The problem was how to get the airplane down

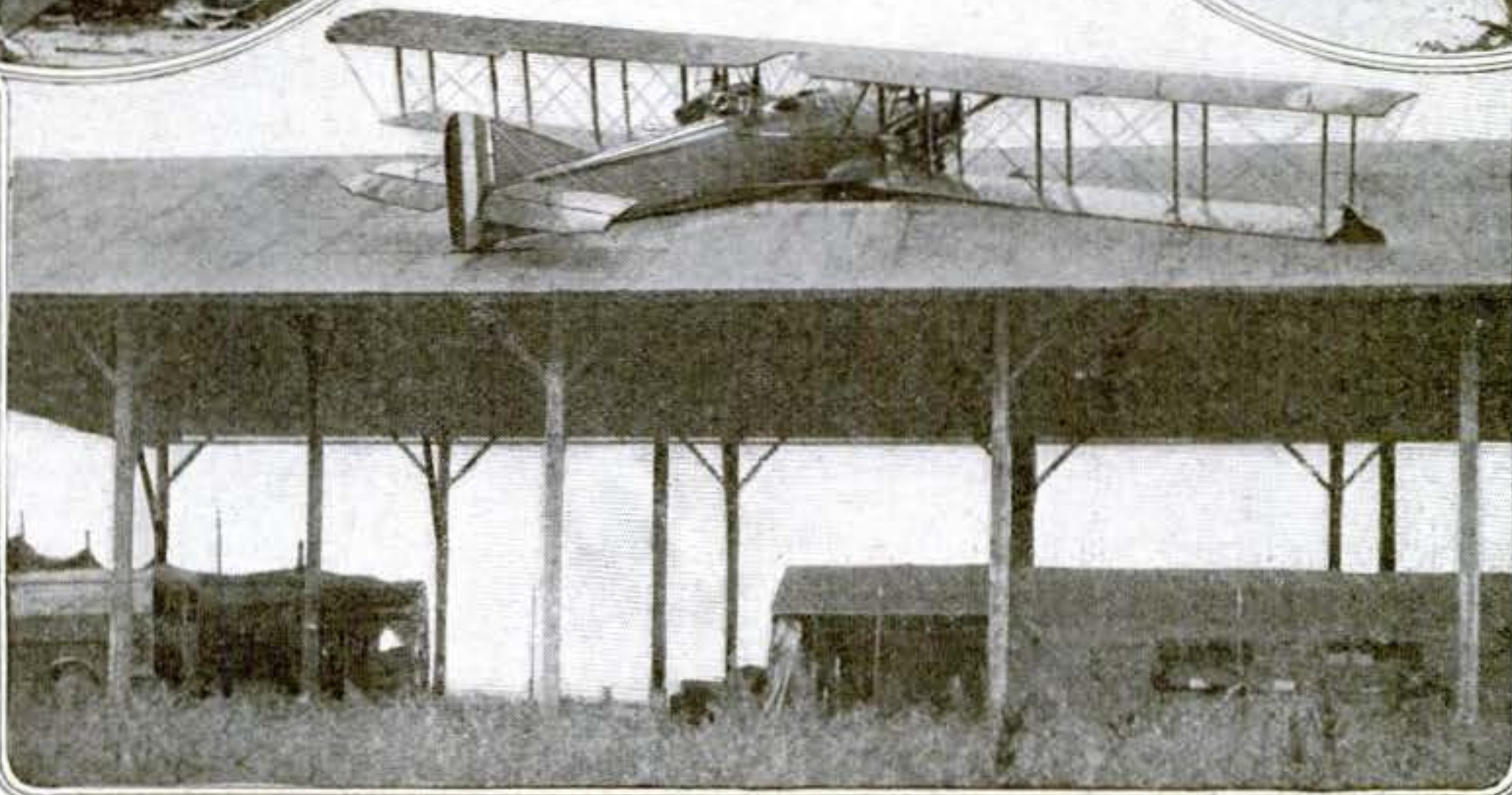


© International Film



© International Film

Landings such as this do not make the birds laugh. In stormy weather the feathered fliers often alight sprawling on the ground with outstretched wings, saved from injury only by the elasticity of their feathers, which is greater than that of any artificial structure



© International Film

For strong modern machines, tree-tops and roofs are good buffers when misfortune or the enemy's fire drive them down out of control, and the manner of landing has to be left to luck. Here the unhurt pilot is crawling out of his intact machine caught in two trees

Foiling Davy Jones

The Maxim Unsinkable Ship, Now Being Constructed Under the Auspices of the United States Government

By Hudson Maxim

THE warhead of the powerful modern German torpedo carries about four hundred pounds of T.N.T. or equivalent high explosive. When a ship is struck by a torpedo deep under water, the action of the explosion is practically instantaneous, and four hundred pounds of white-hot gases are liberated, exerting an instant pressure in all directions of 300,000 pounds to the square inch.

The mass of water surrounding the warhead is as unyielding as rock, so that the explosive blast is directed on the line of least resistance, inward and upward through the ship's hull, the gases rushing out laterally between the ship's hull and the water, bending the hull in over an area sometimes forty feet in diameter, while the gases burst through, expanding in the form of a cone.

Three thousand feet a second is fast for a cannon-ball, but this ball of incandescent gases moves at the rate of thirty miles a second—at the speed of a meteor.

One volume of T.N.T., when exploded, is converted into a thousand volumes of gases after they have cooled down to atmospheric temperature and pressure; but, as at the instant of detonation they have a temperature of 5,000 degrees Fahrenheit, their volume is ten times as great: one volume of explosives makes ten thousand volumes of gases. The four hundred pounds of T.N.T. in the German torpedo-warhead occupy about four cubic feet of space and liberate about forty thousand cubic feet of gases. The pressure exerted inside a ship's hull by such an enormous volume of gases is so great that often the ship is broken in two, as in the case of the *Sussex*.

Wanted—a Shock-Absorber

Many experiments have been conducted, both here and abroad, for the purpose of discovering the best means of protecting the hull of a ship against torpedoes. All manner of externally applied devices, such as booms, nets, and shields, have been considered, but have not been found satisfactory.

When a ship is provided with a strong longitudinal wing bulkhead situated at a distance of, say, twelve feet inboard from the hull-wall of the ship, a sufficient mass of buffer cargo, with expansion spaces for the gases, may be placed in the space between the hull-wall and the bulkhead effectually to resist and absorb the blast of the torpedo, so that the bulkhead will not be disrupted. My plan of protecting ships is an embodiment of



Mr. Maxim, inventor of the smokeless powder used by our Army and Navy, is one of the foremost authorities on high explosives. As a member of the Naval Consulting Board, he knows better than any layman the crucial difficulties of our shipping problem. His plan of protecting ships, described in the article on this page, has been selected by the United States Shipping Board from thousands submitted to it.—The Editor.

these conclusions. I have found that pulverized coal, on account of its compressibility and elasticity, is a very effectual shock-absorber. As pulverized coal may be used for driving the ship, I have chosen it as the main shock-absorber. The idea has been offered to the United States Government free of charge during the war.

When a torpedo strikes a ship constructed according to my plan, the hot, rapidly expanding gases first encounter a barrier of water or oil in the hull, then a stout screen of round steel rods, and lastly a series of vertical steel cylinders in which powdered coal is carried. Since it is essential that the gases should be allowed to expand without bursting the ship's compartments, I provide free upward vents through the ship's deck.

When the Ship Is Struck

If such a ship should be struck by a torpedo, the water or oil of the barrier in the path of the blast will be driven forward through the steel screen, commingling its spray with the hot gases, with the result that the heat of the gases will be instantly absorbed by the spray and their volume reduced. It is safe to assume, I think, that the volume of gases will be reduced at least three quarters.

The result of the explosion of a torpedo-warhead against this structure will be to smash a hole through the hull-wall, carrying forward a large mass of the water or oil of the barrier, and hurling the liquid upon and through the first steel screen, bending the screen somewhat.

The outer wall of the powdered coal-cylinders in the path of the blast will be disrupted, and the liquid spray and powdered coal will be carried along together and hurled against the strong screen centrally located in the cylinders; the gases of the explosion and liquid spray and the pulverized coal will be commingled. Although even this strong steel screen should yield or bend somewhat under the blast, it will not be entirely carried away or broken through.

By that time the gases will be vented upward through the top of the cylinders into the atmosphere; the energy of the blast will be so absorbed and dissipated that the inboard wall of the cylinders—that is to say, the bulkhead constituted by the inner wall of the cylinders—will be entirely uninjured and can not be broken through. Consequently, the only amount of water that can enter the ship will be that which will fill the space between the transverse bulkheads and the inner wall of the cylinders.

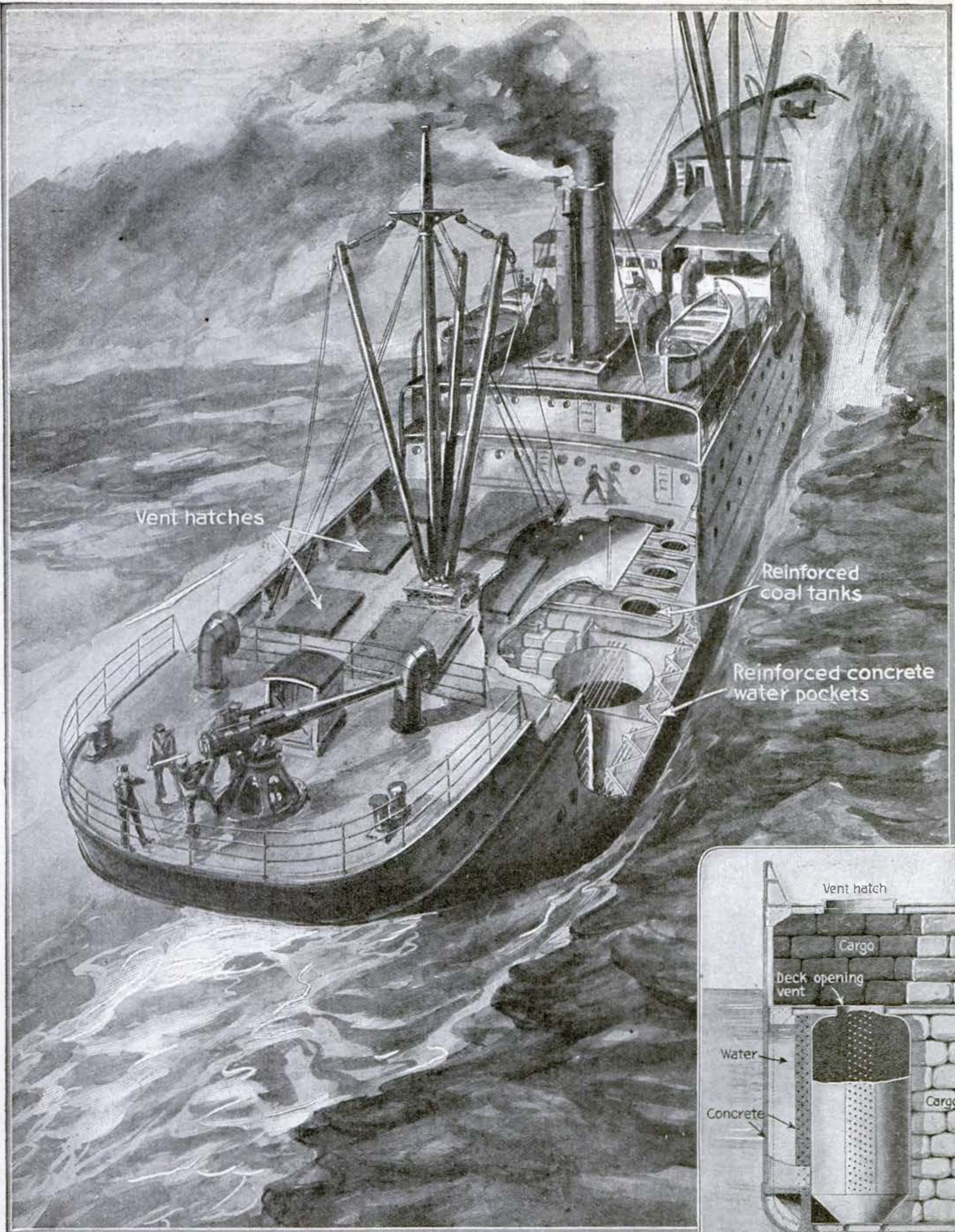
Keeping Up with the Submarines

The use of pulverized coal on shore has long passed the experimental stage, and it is admirably adapted to use on board ship. It will save twenty per cent. of the coal consumption, besides producing no smoke. Means have already been developed and perfected by which pulverized coal may be piped from the cylinders to any portion of the ship by air pressure as freely and effectually as oil is piped.

We are trying hard to build ships faster than the submarines can devour them; but, in spite of all our efforts, the submarines have devoured in the past year more than twice as much shipping as the Allied nations have been able to build. The loss has been more than \$6,000 a minute.

But it is not the market value, or the value in terms of cost of shipping and of supplies lost, that we are to consider. Our resources are so vast that we can stand the drain, provided we can send across the Atlantic in safety the necessary number of ships to carry the required quantity of supplies and the needed number of men to France.

It is to meet this crucial situation that I have invented the ship here described.



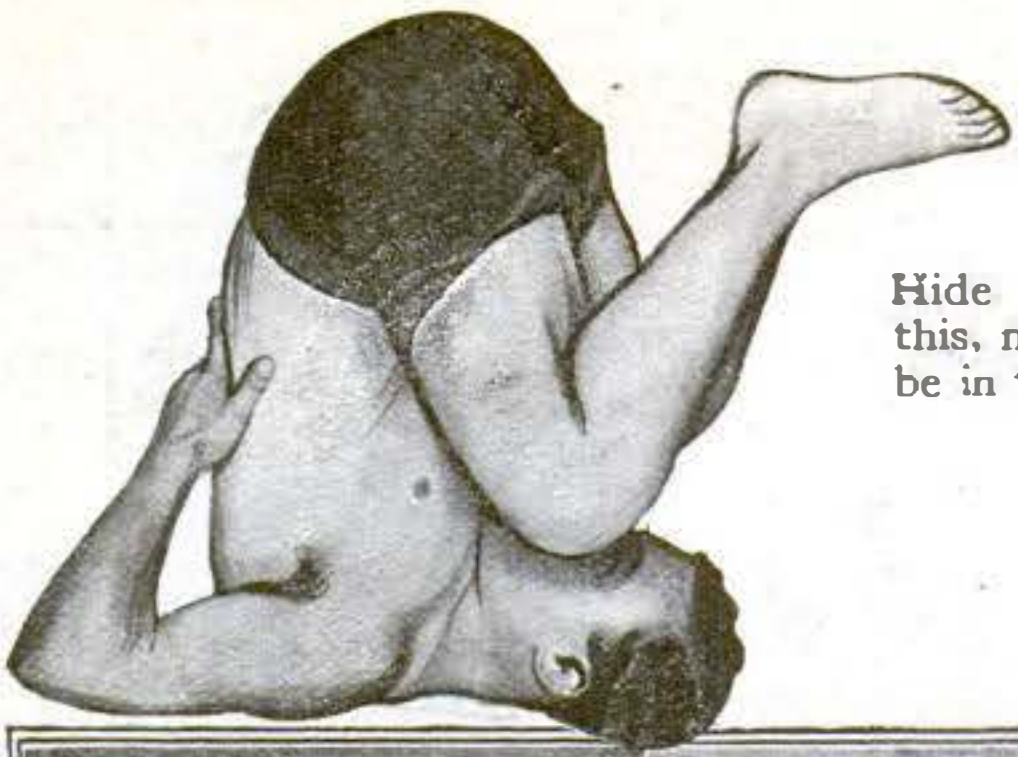
Hudson Maxim's Torpedo-Proof Ship, Which the Shipping Board Is Now Building

Around that portion of the ship likely to be struck by a torpedo is a water-jacket, which may be filled with fuel oil or with water. This structure constitutes the water or oil barrier referred to in Mr. Maxim's article. A series of vertical steel cylinders for carrying pulverized coal is placed just inside of the liquid barrier, connected with and forming an integral part of it. Through the center

of the cylinders is run a screen of steel rods welded to the walls of the cylinders. All connections are made by welding, so that the system of cylinders is an integral part of the hull wall of the ship. On a ship of 9,500 dead-weight tonnage the steel cylinders will be about ten feet in diameter and hold about thirty tons of powdered coal each. It is a ship of this size that is to be built

Did the Recruiting Officer

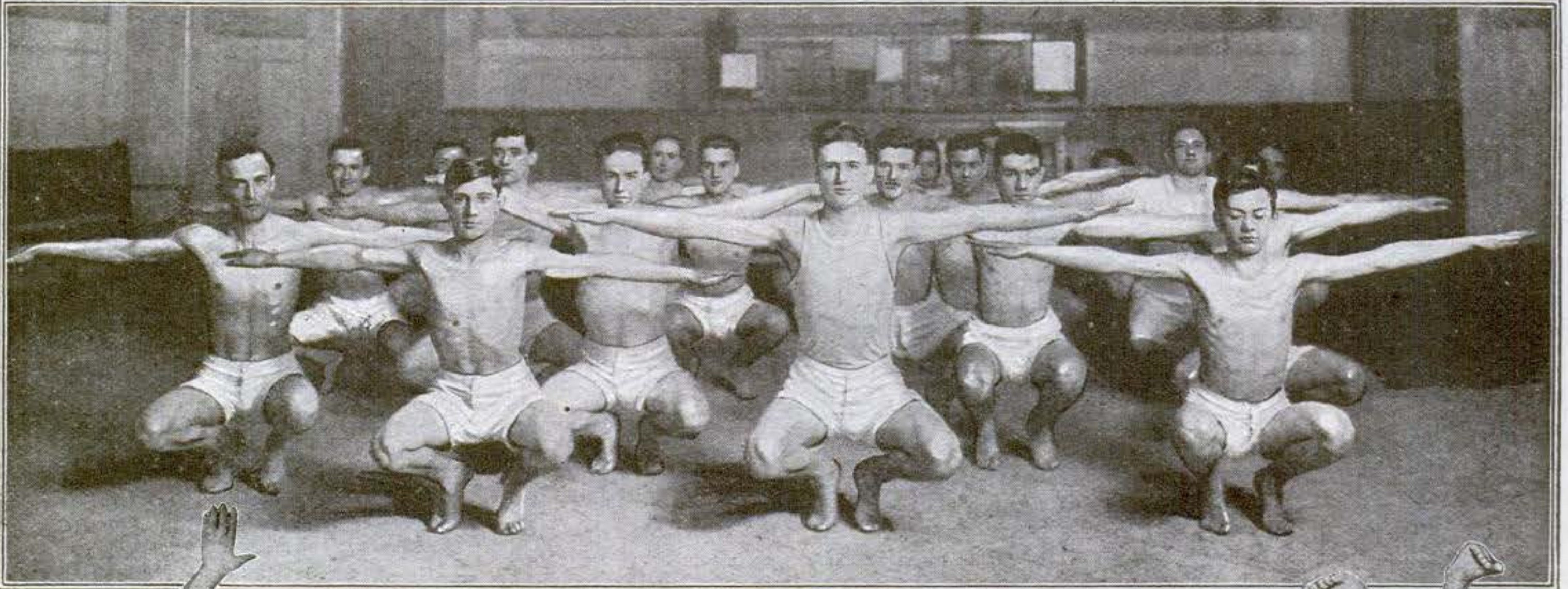
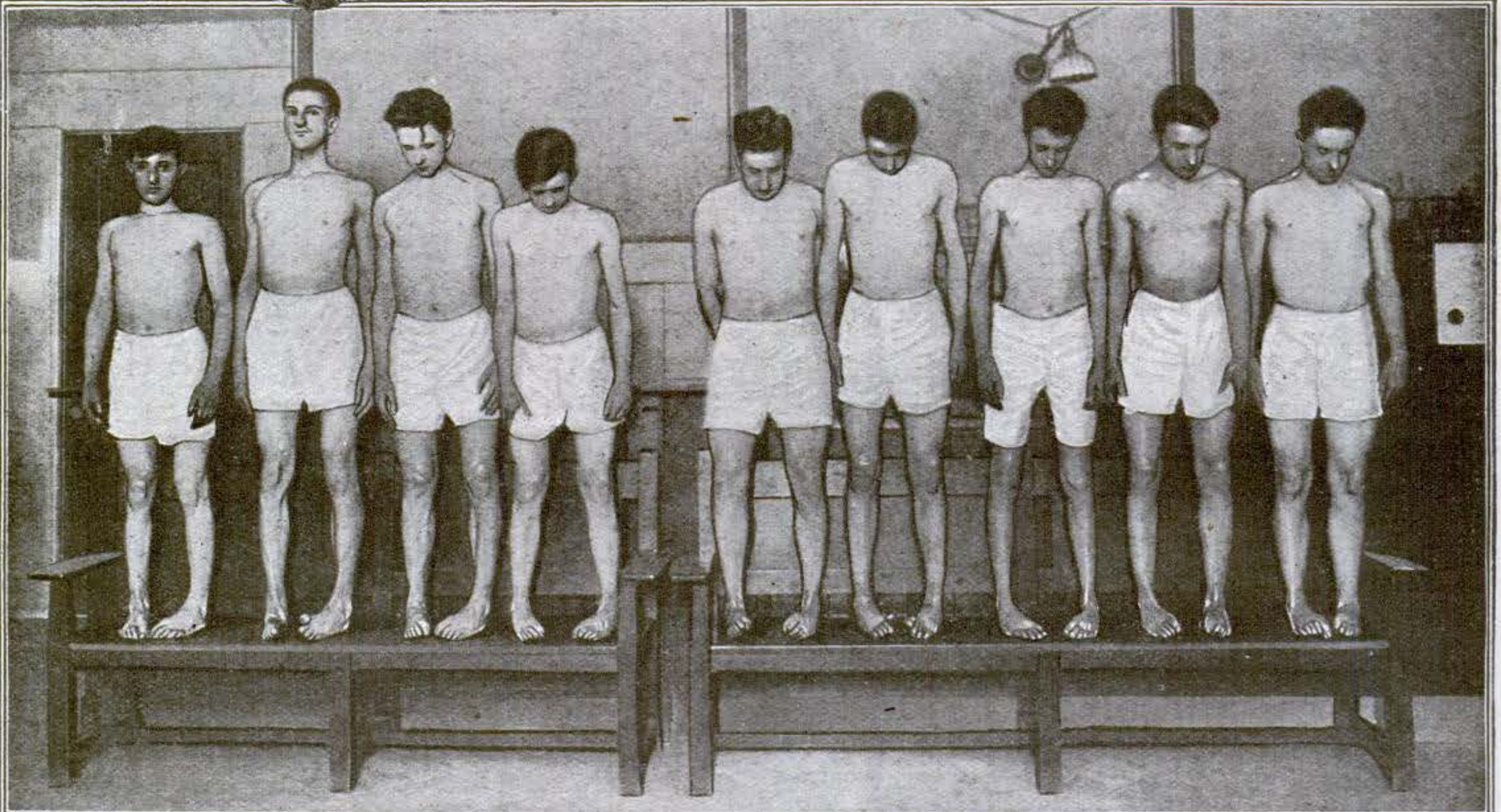
Photographs courtesy of Cornell University Medical College



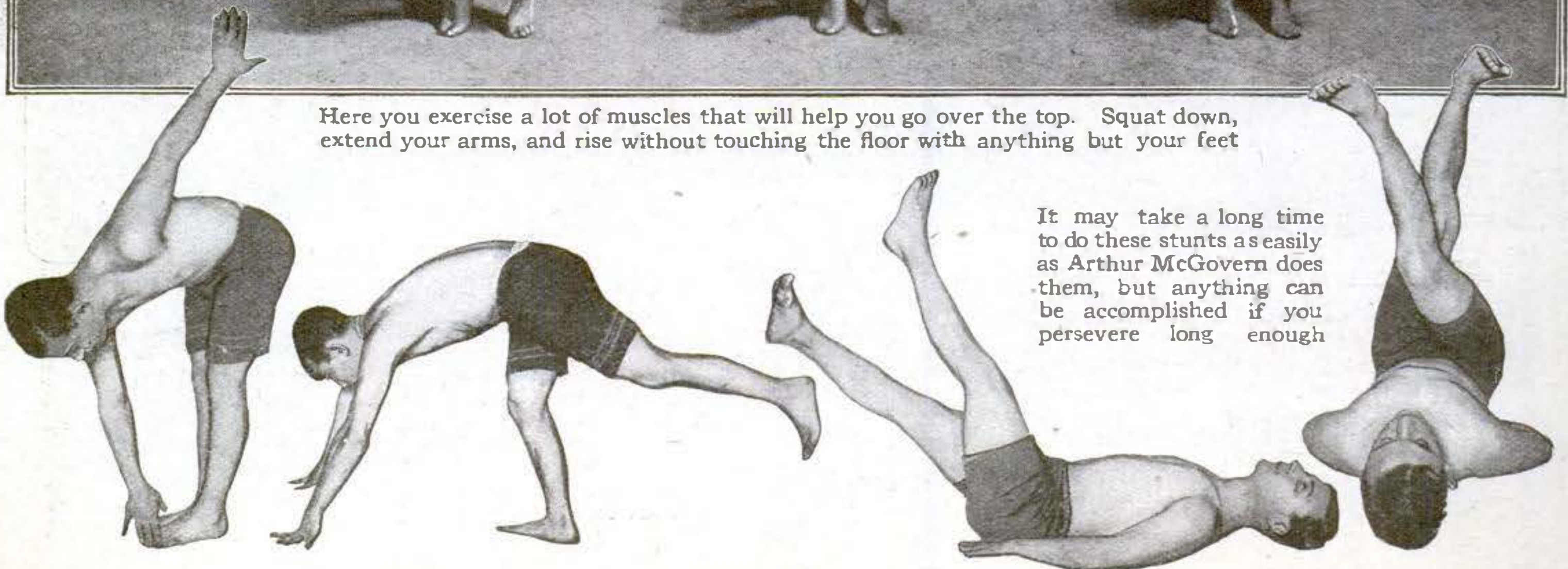
Hide your face with your knees, like this, many times a day, and you'll soon be in the uniform of the United States

If you have flat feet, try this exercise. Do it several times a day, whenever you can, and before long you will develop a pair of feet that will be well equipped to carry you on that march to Berlin

IT'S pretty tough, fellows, to be kept out of the world's biggest scrap just because you've got flat feet, weigh a few pounds more or less than you should, or have a slight physical defect. But don't give up, if you really want to go. At



Here you exercise a lot of muscles that will help you go over the top. Squat down, extend your arms, and rise without touching the floor with anything but your feet



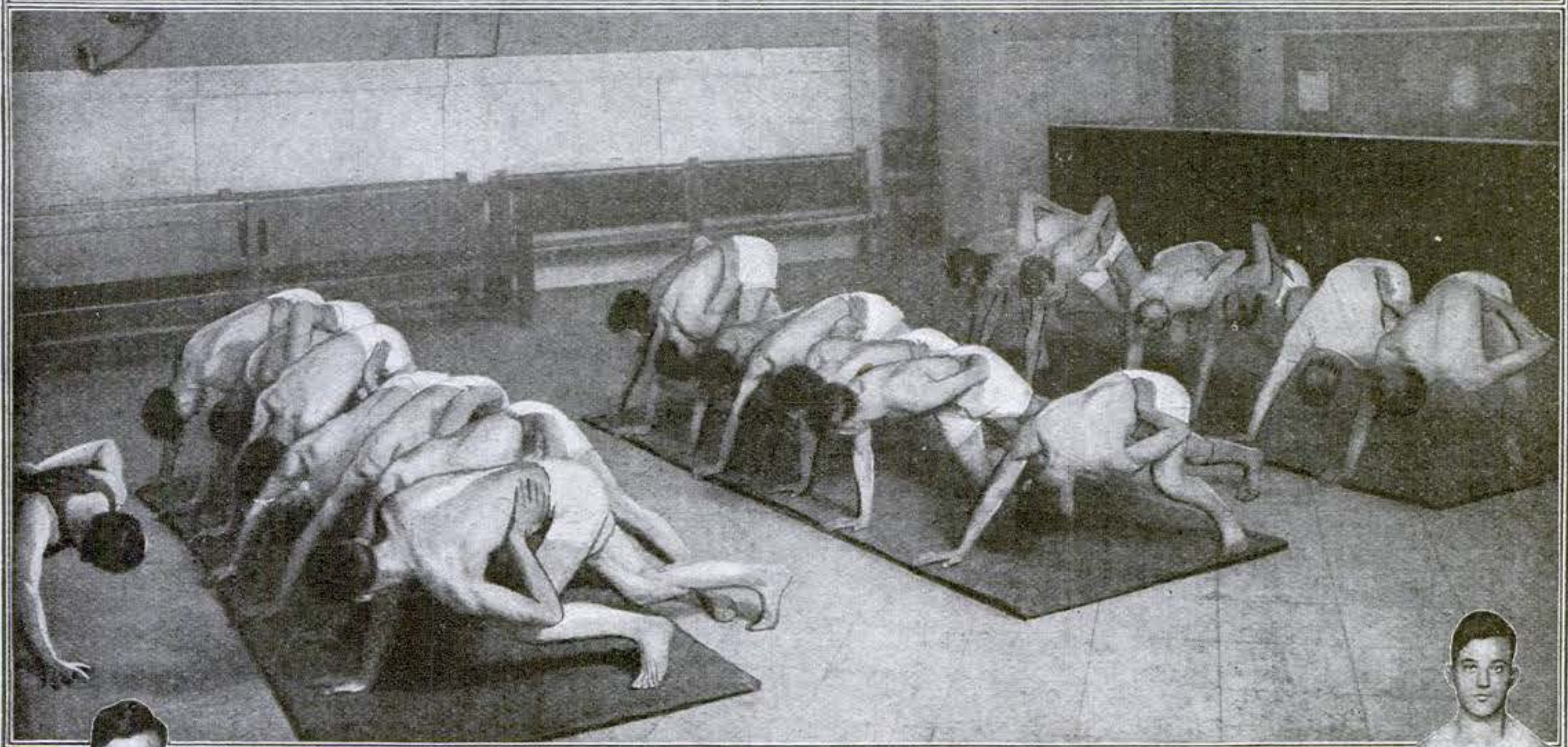
It may take a long time to do these stunts as easily as Arthur McGovern does them, but anything can be accomplished if you persevere long enough

Say No to You? Try This

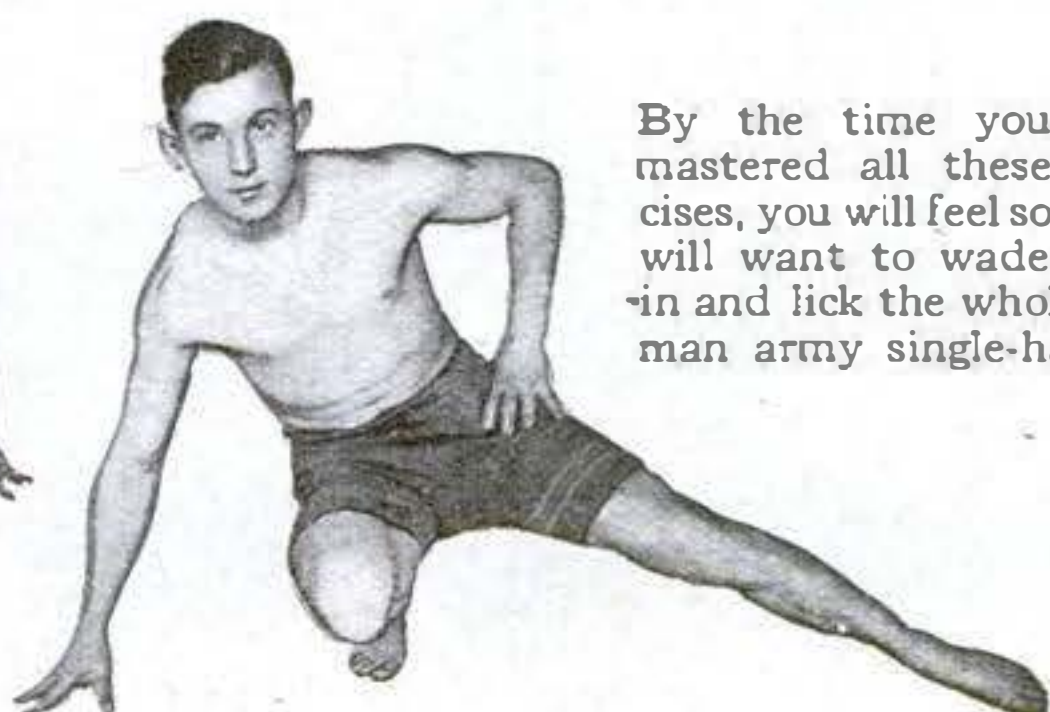
Cornell University Medical College, in New York city, there is a Reclamation Clinic, conducted by Dr. W. H. Sheldon, where would-be soldiers are being made into the real thing. Arthur A. McGovern puts the boys through their physical paces

Raise both legs as far over your head as you can, then swing them from side to side, trying each time to touch the floor

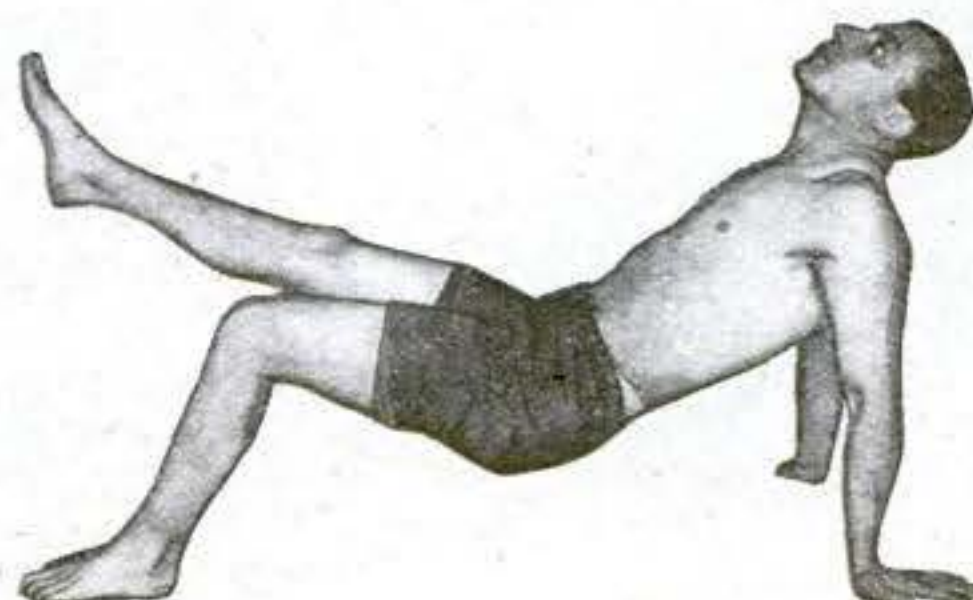
This is harder than it looks. Touch the outside of the left foot with the right hand, and swing the left hand behind you, then touch the right foot with the left hand



This is a difficult exercise, but the boys are all doing their best. Try to see how soon you can do it yourself after you have worked up to it by learning all the simpler ones



By the time you have mastered all these exercises, you will feel so fit you will want to wade right in and lick the whole German army single-handed.

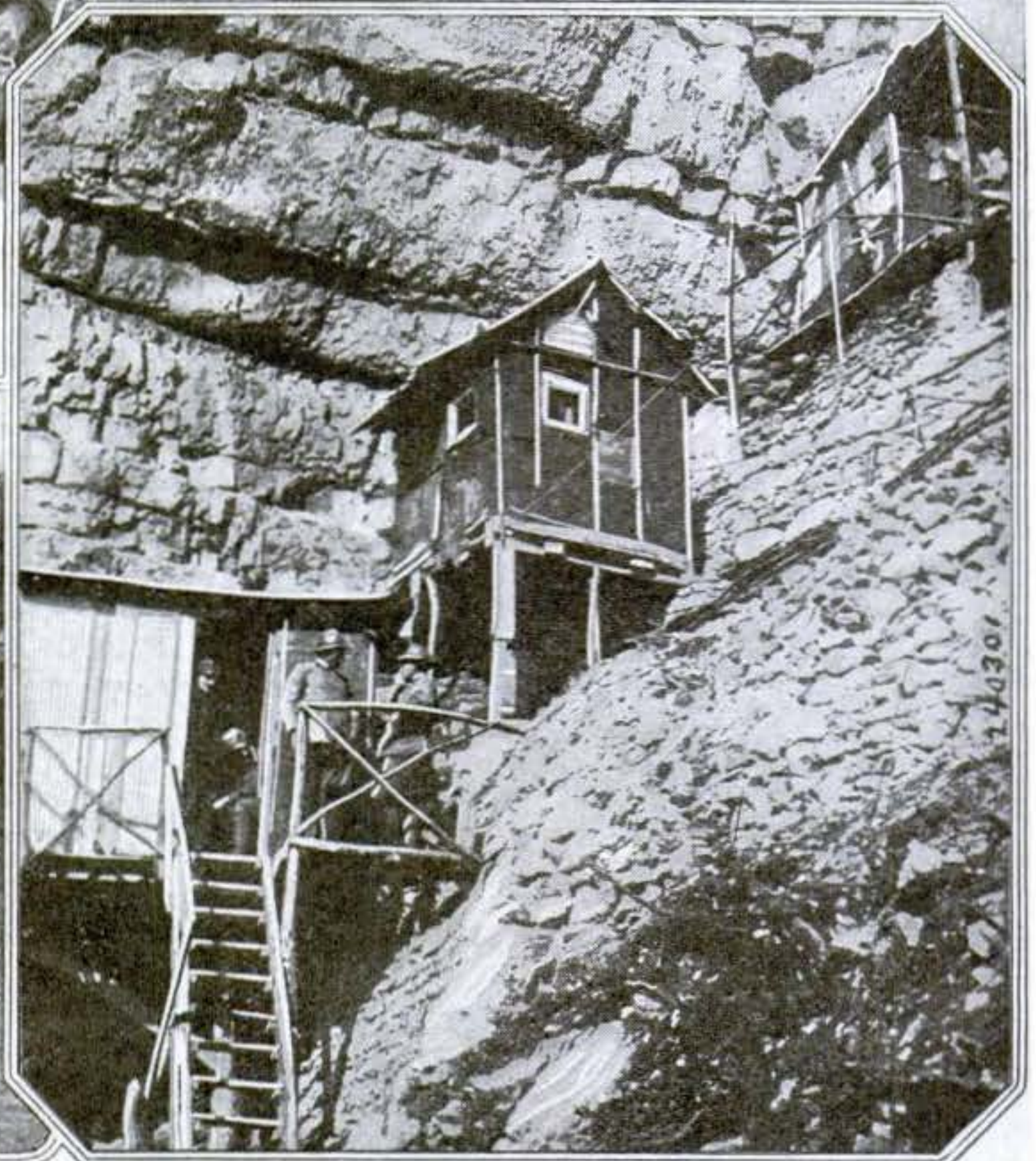


Light Housekeeping for Bachelors at the Front

Photographs © Underwood and Underwood



This is not a kennel for the dogs of war, but an advanced telephone post where Italian soldiers report what's doing in the country of their enemy, Austria



If you dwell with Italy's Alpini, you must watch your step. These daring soldiers perform wonderful feats of engineering in transporting men and ammunition



Two inscriptions in French on this hut say, "Very fragile," but it doesn't apply to its present occupants, fighting airmen, tough as steel and whip-cord. It is quite fitting that the box that brought parts of their airplanes to the front should now house them. On the same principle, Paderewski's cottage ought to be a piano-box



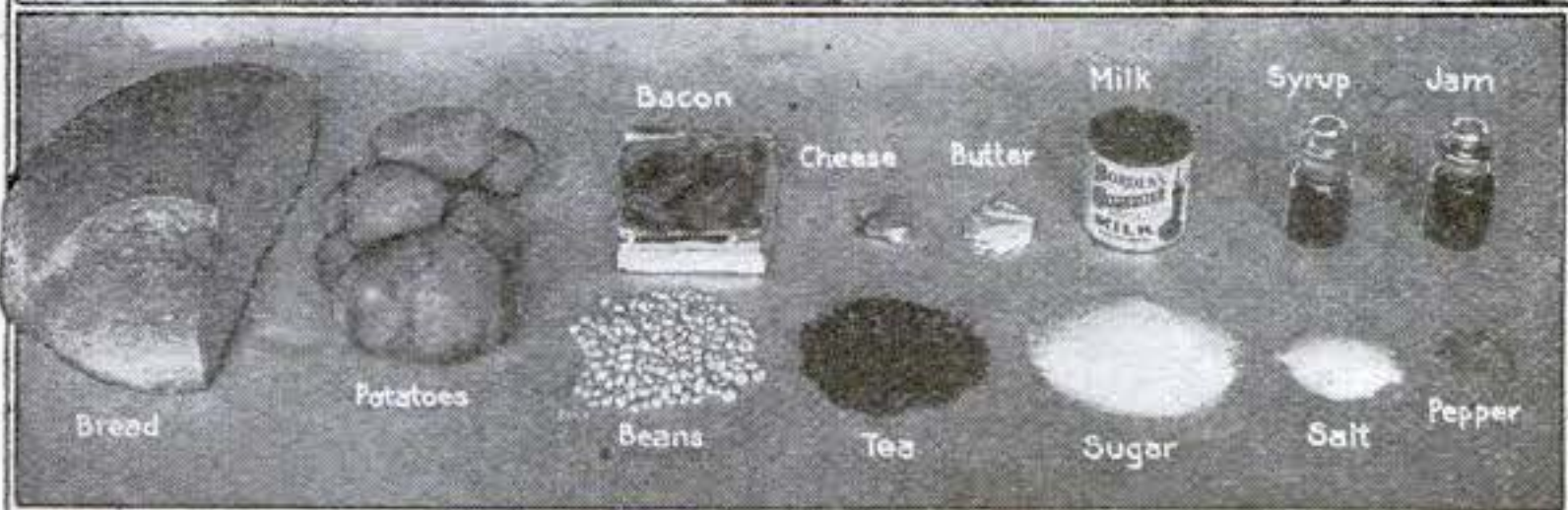
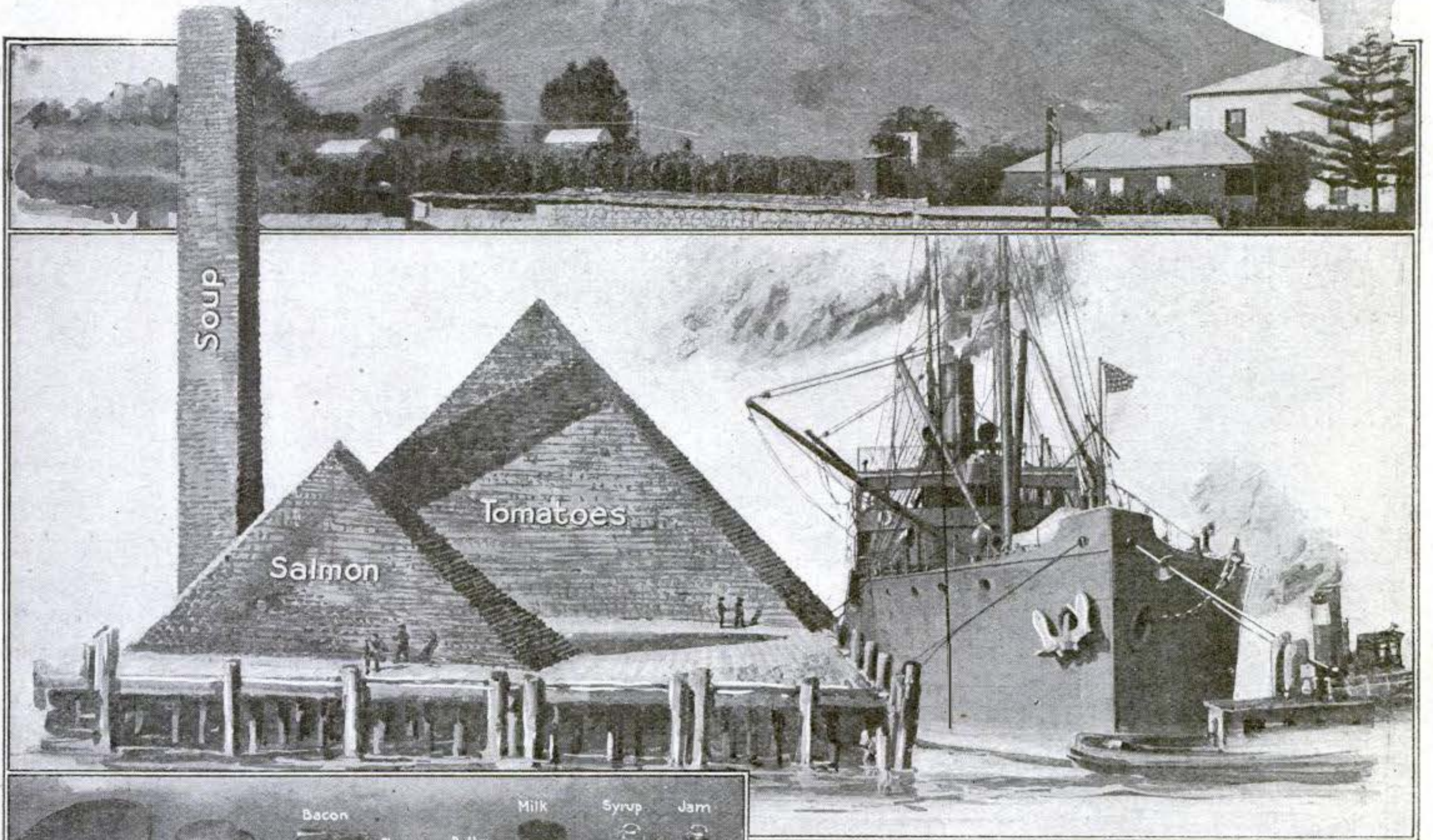
Cramped quarters, but the men look happy. And why not? The cast-off automobile top, which has become the home of a French poilu and a British Tommy, boasts a real window, and all who enter must bow their heads

In war, home is any place you can hang your tin hat. These two soldiers were unusually fortunate in securing this tight little cottage, once a German motor-body

What It Means to Feed an Army of 2,000,000



This American giant soldier, typifying the 2,000,000 men in the United States Army, is preparing his morning coffee. For proper brewing he requires the heat of a volcano, such as the Stromboli. In the course of a year he consumes coffee amounting to one twentieth of the export from Brazil—and Brazil supplies half of the world with this popular beverage



To supply our giant with food, a ship an hour must sail from American wharves. Here are some of his week's rations: 290,000 two-pound cans of salmon; 200,000 cans of soup; 1,141,000 cans of tomatoes; 10,000,000 loaves of bread; and 28,000 head of cattle are slaughtered for him each week

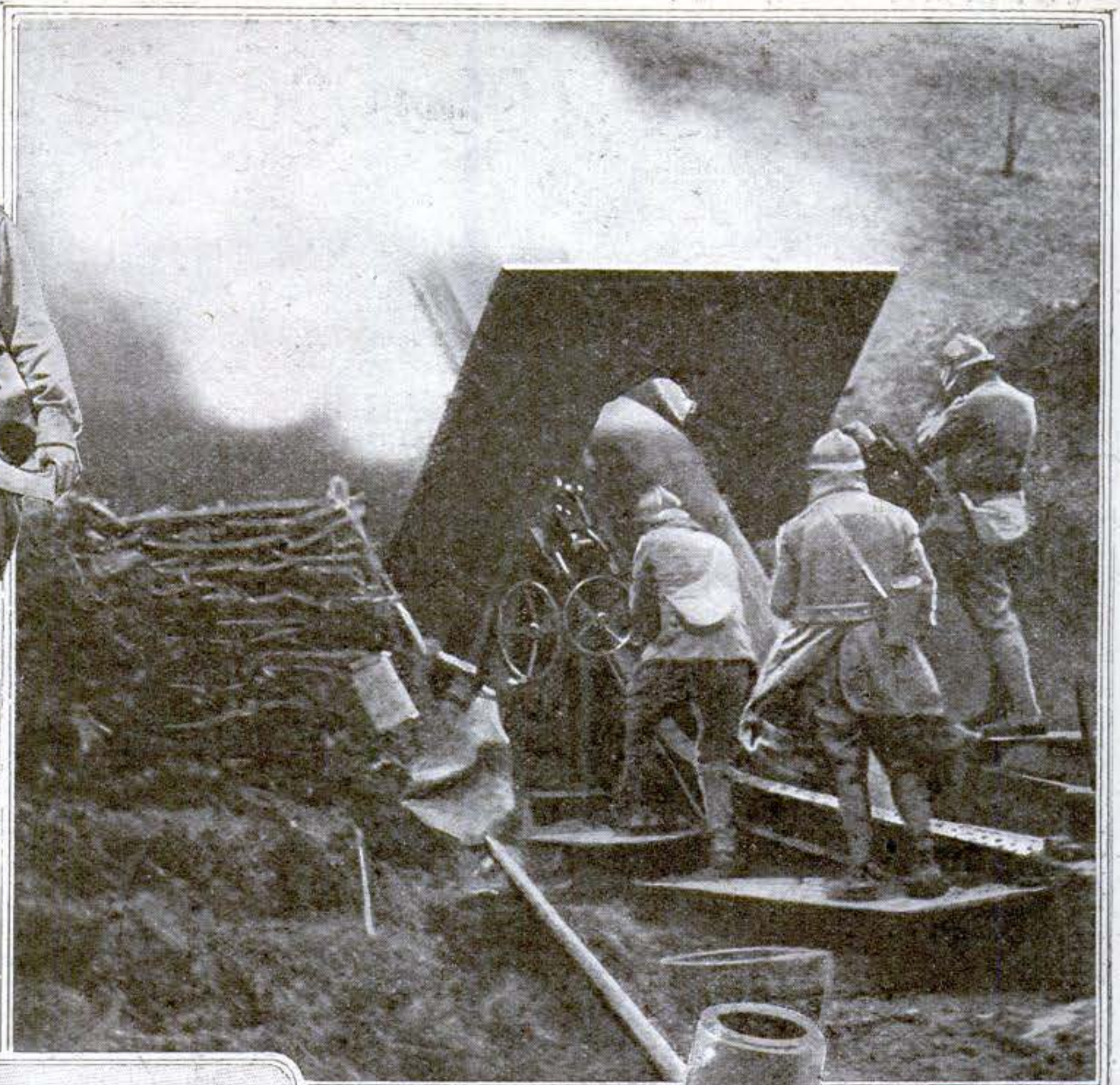
An American soldier's rations for one day

"Dear Wilhelm: In Reply

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This, dear Wilhelm, is Student Officer Engleberg, the smallest American in training. We mention his stature, so that you may correctly gage the 12-inch shell beside which he is standing and its charge of powder



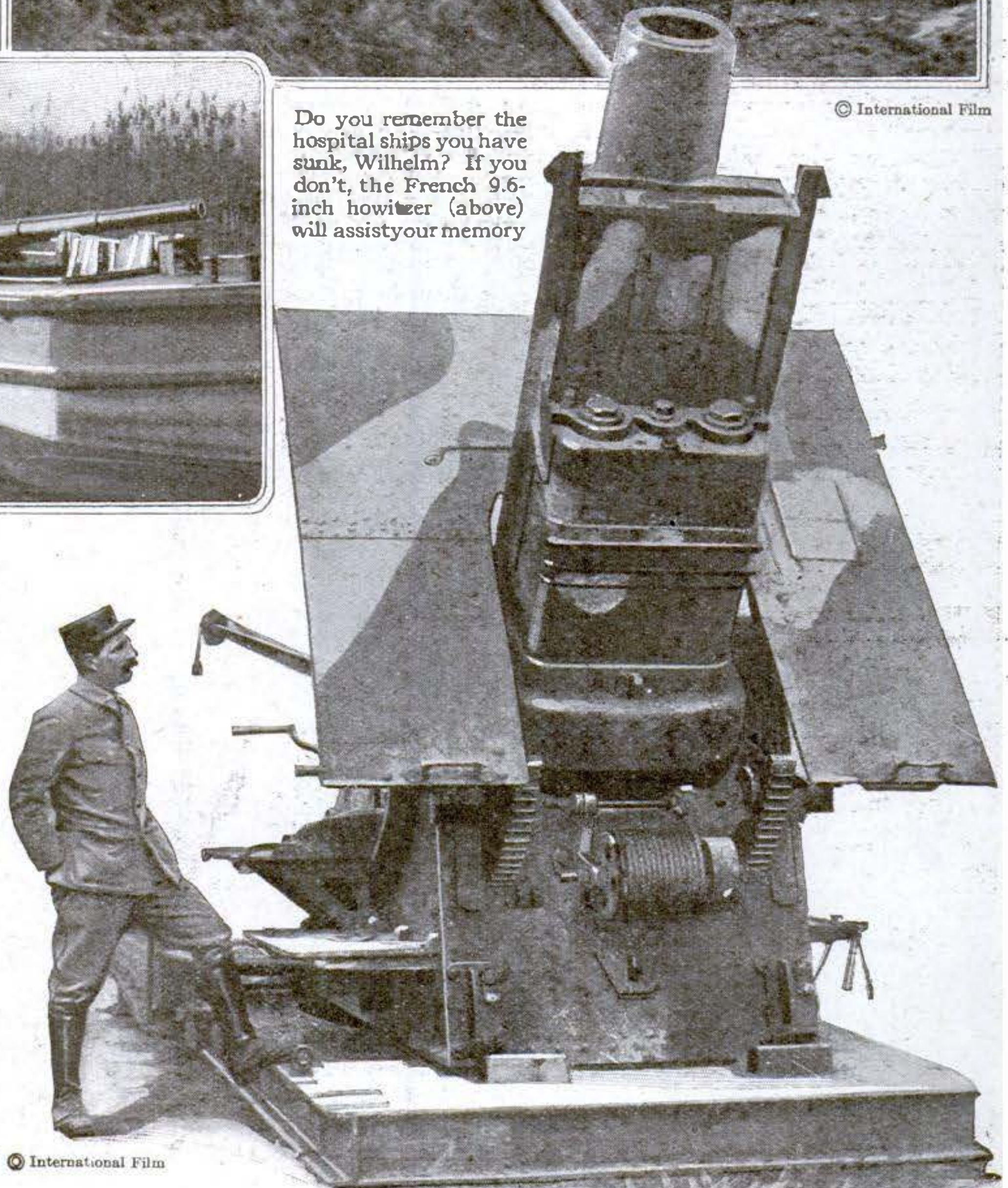
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Italian Official Photograph

The Italians were so bent on conveying their compliments to you, dear Wilhelm, that they sent you and your Austrian ally messages that thundered from a scow on the River Marino, below the Piave.

Eyes right, Wilhelm. If it hadn't been for that little Belgium business, who knows whether this 11.2-inch Creusot howitzer would ever have been built? As you have probably discovered by this time, Wilhelm, this howitzer fires three shells every minute (quick work, you must admit, for so huge a piece), and that from a distance of ten miles



© International Film

to Yours of Recent Date"

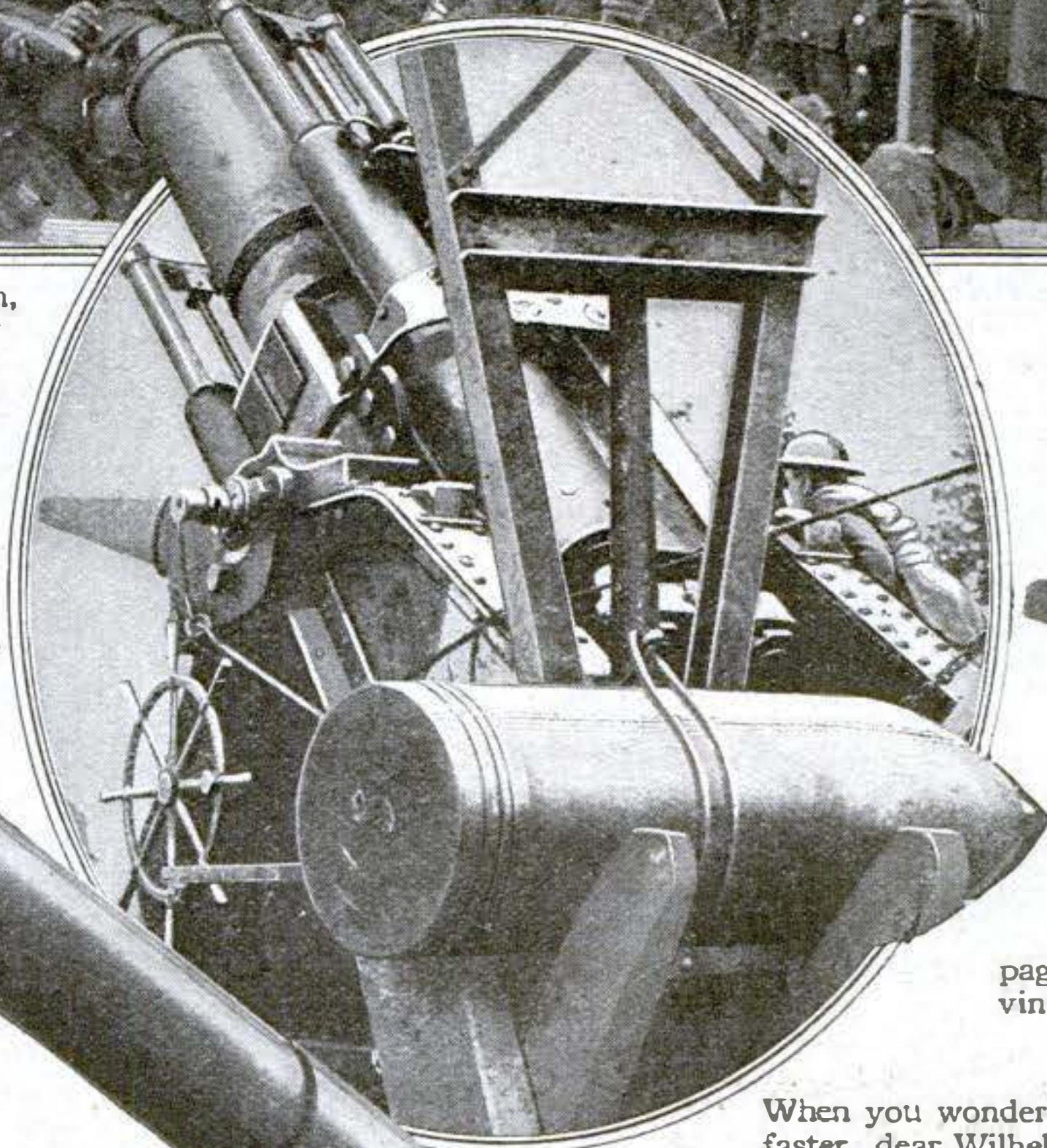


You will recognize the shells, Wilhelm, as the common variety fired by field artillery. We regard them as the dots on the "i's" of the messages flung at you



Copyright International Film

Meet Colonel Thompson of the United States Coast Artillery, dear Wilhelm. He is in charge of a big 16-inch French gun like the one that thrusts its barrel across the page. The Colonel will try to convince you that we are in the war



When you wonder why you are not progressing faster, dear Wilhelm, gaze on the picture in the oval. It's one of Haig's "heaviest." It will bury a high-explosive shell twenty feet in the ground and blow the quarters of your officers into a geyser of dirt. You must have seen the phenomenon

Copyright International Film

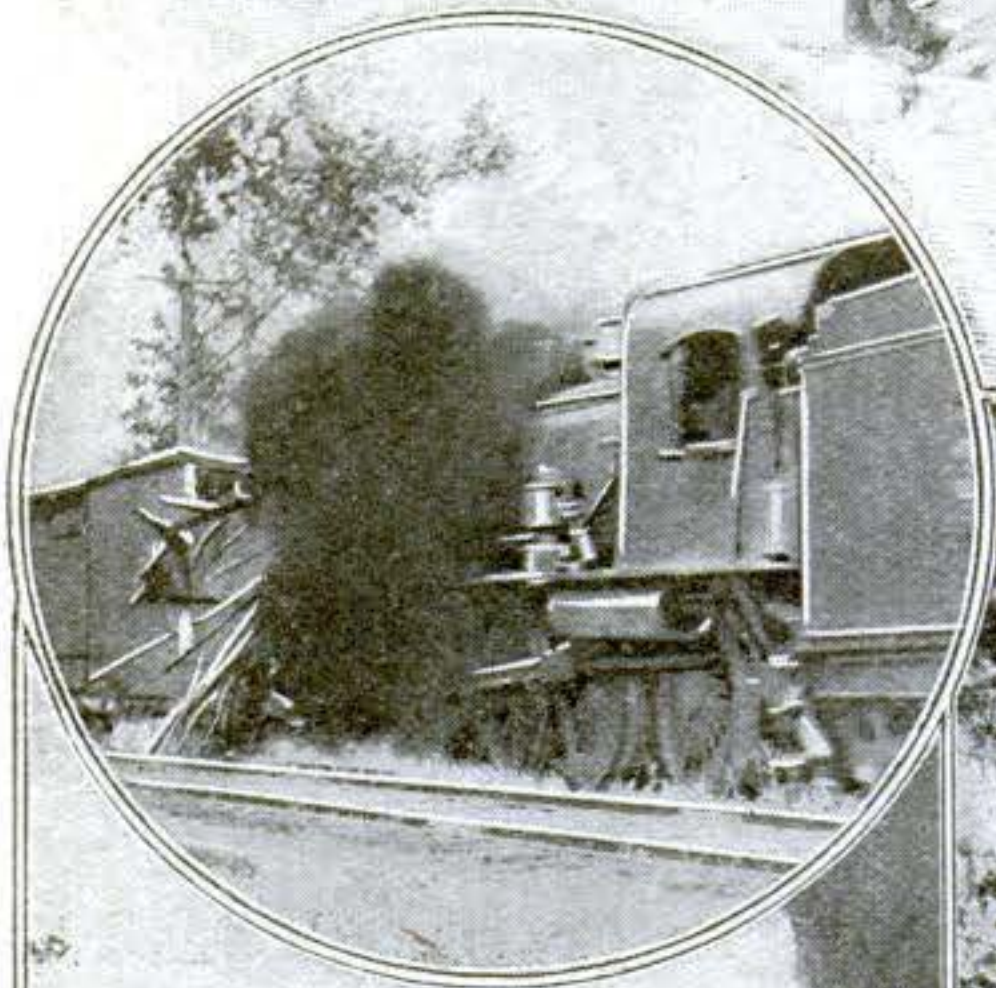
And now, dear Wilhelm, let us bring up the *Lusitania*. We mean to remind you of her constantly with the assistance of 16-inch naval guns mounted on railway trucks. Every shot screams her name through the air



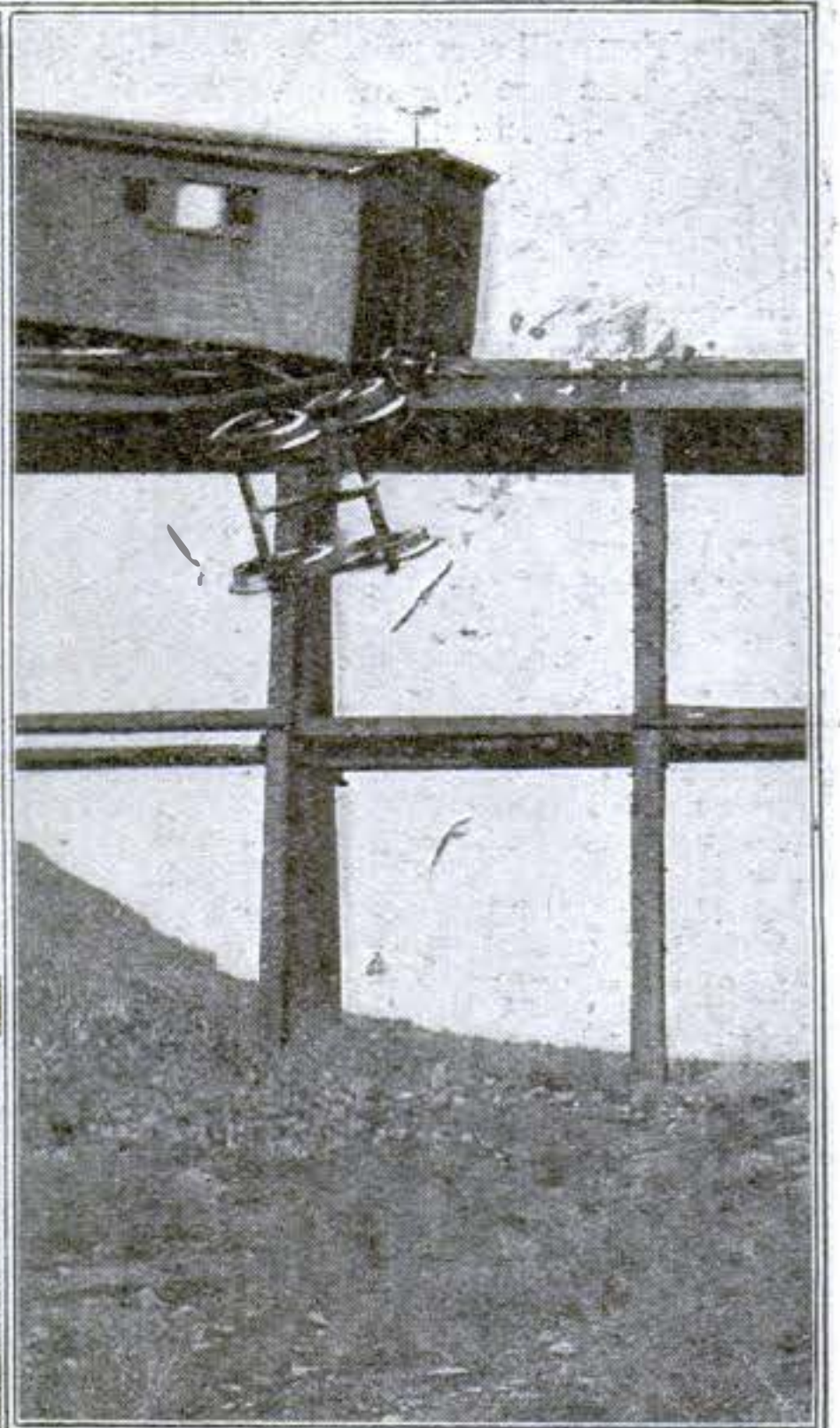
Thrillers by the Foot

Before the war at least two railroads made from \$30,000 to \$50,000 a year staging train wrecks for the "movies." The picture in the circle shows a fast freight being wrecked for the "silent drama"

Cleaning up after a moving-picture wreck is a tough job, because, while a train may get off easily in a collision in real life, it is certain to be all "busted up" in reel life



The villain (curse him) responsible for this terrible head-on smash listens in while Si Perkins is telling the conductor of his suspicions

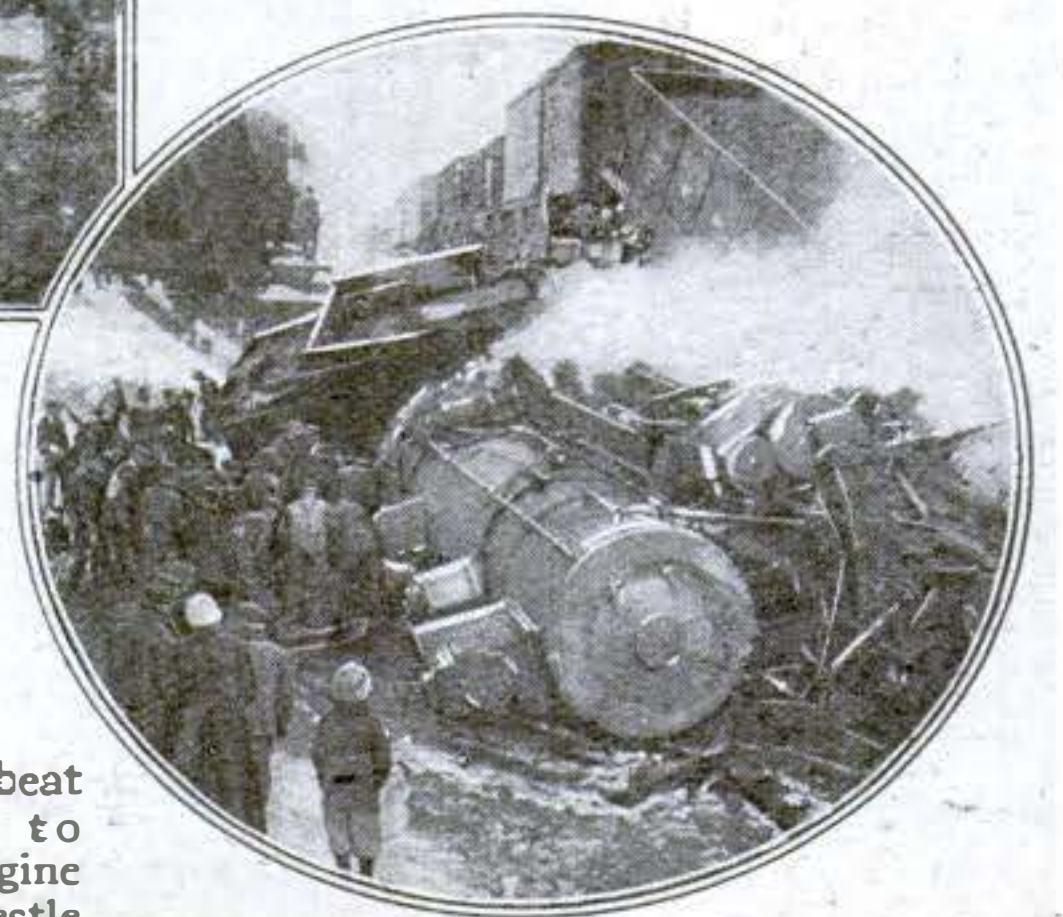


On a blind siding one motion-picture company has set out twenty box-cars salvaged from wrecks like this that it has staged for the "movies"

When there's a young woman at the throttle, the train is pretty apt to be safe—in "movie"-land



One film company, since its organization, has purchased and demolished in this spectacular way enough rolling stock to outfit a prosperous branch line



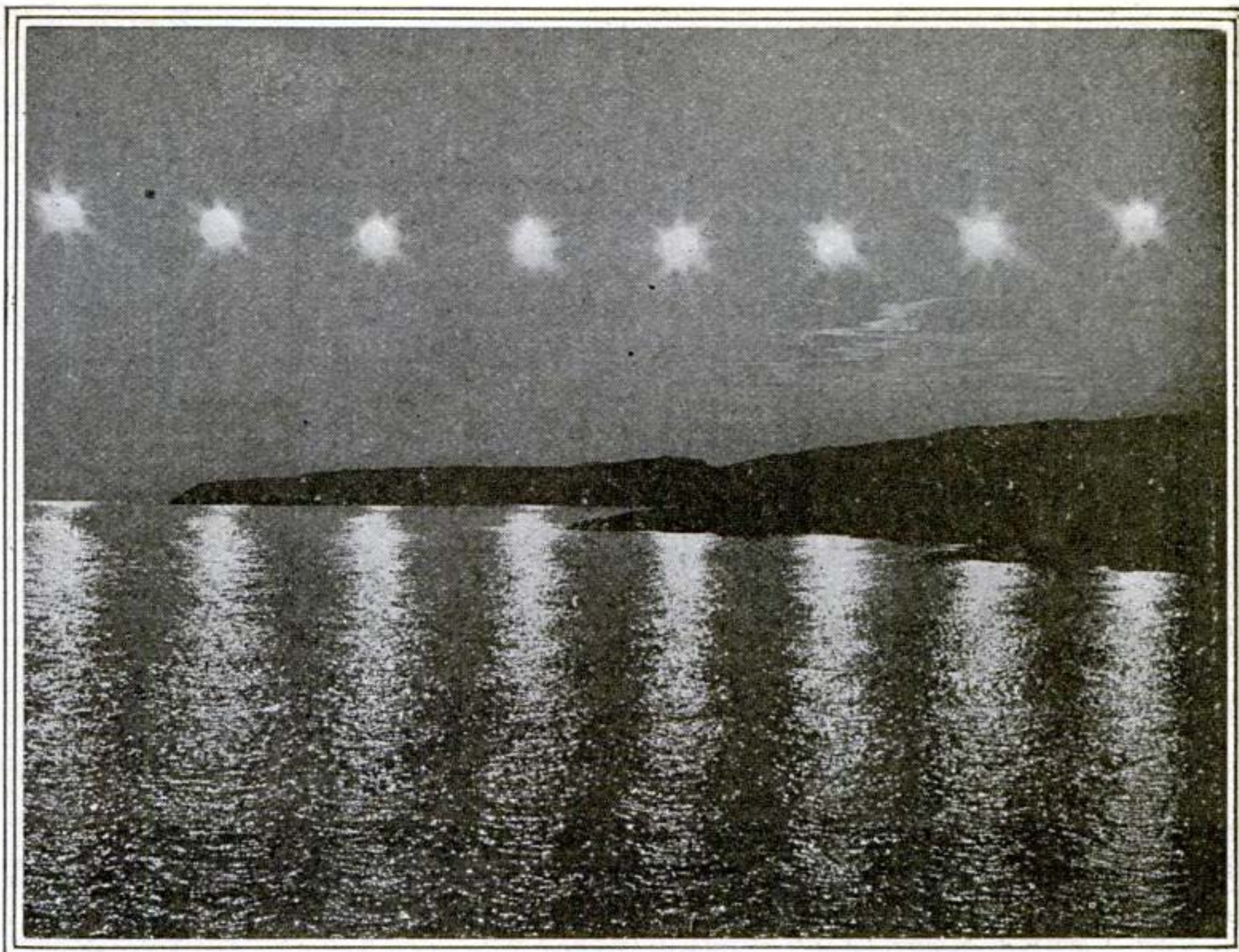
But no "movie" director could beat this wreck, which happens to be the real thing. The engine fell twenty feet through a trestle

Our Captive Sun, Slave to a Beaten Path

THE sun does not climb straight up in the sky, but obliquely. What is more, his rising point is not the same on two succeeding days. As spring merges into summer the rising point shifts to the north. After June 21, he shifts south, so that on each day he begins his climbing a little more to the south. By December 22 he has reached his southern limit and turns back again.

Since there is a defined region on the eastern horizon along which the sun's rising point shifts in regular order and beyond which it never strays, the daily paths of the sun through the sky in the year form an unshifting, unchanging band of even width—the same band from year to year.

As you go north the sun's path slopes more and more. The band remains the same; it merely swerves up or down in the sky. Hence in the arctic regions the sun during the spring and summer months appears above the horizon, and stays there, traveling around in a circle, and becomes the "Midnight Sun."



Photograph by D. B. MacMillan, leader of the Crocker Land Expedition.

Courtesy American Museum of Natural History

In the Land of the Midnight Sun there is no night to speak of. The sun travels around the horizon. The photographer tried to bring out this fact by making several exposures

Why Are There Giants and Dwarfs?

PATRICK COTTER was an Irishman over eight feet high. He could take off the top of a street-lamp and light his pipe by the flame. Geoffrey Hudson, a dwarf who amused Charles I., was only eighteen inches tall.

Why was Cotter so big and Hudson so little? There are Cotters and Hudsons today, although they are more likely to be found in the side-

shows of a circus than at the court of a king. Science has lately been studying the question, with the result that a whole new branch of medicine will have to be mastered by the doctor of the future.

A man cannot grow in the right way, it seems, unless his blood receives important contributions from several small organs, one of which is called the "thyroid" gland. Yours is in your neck. When the thyroid of a child is not furnishing enough of its peculiar product, dire results follow. A misshapen creature develops. Worse still, the mind, too, is dwarfed to idiotic proportions.

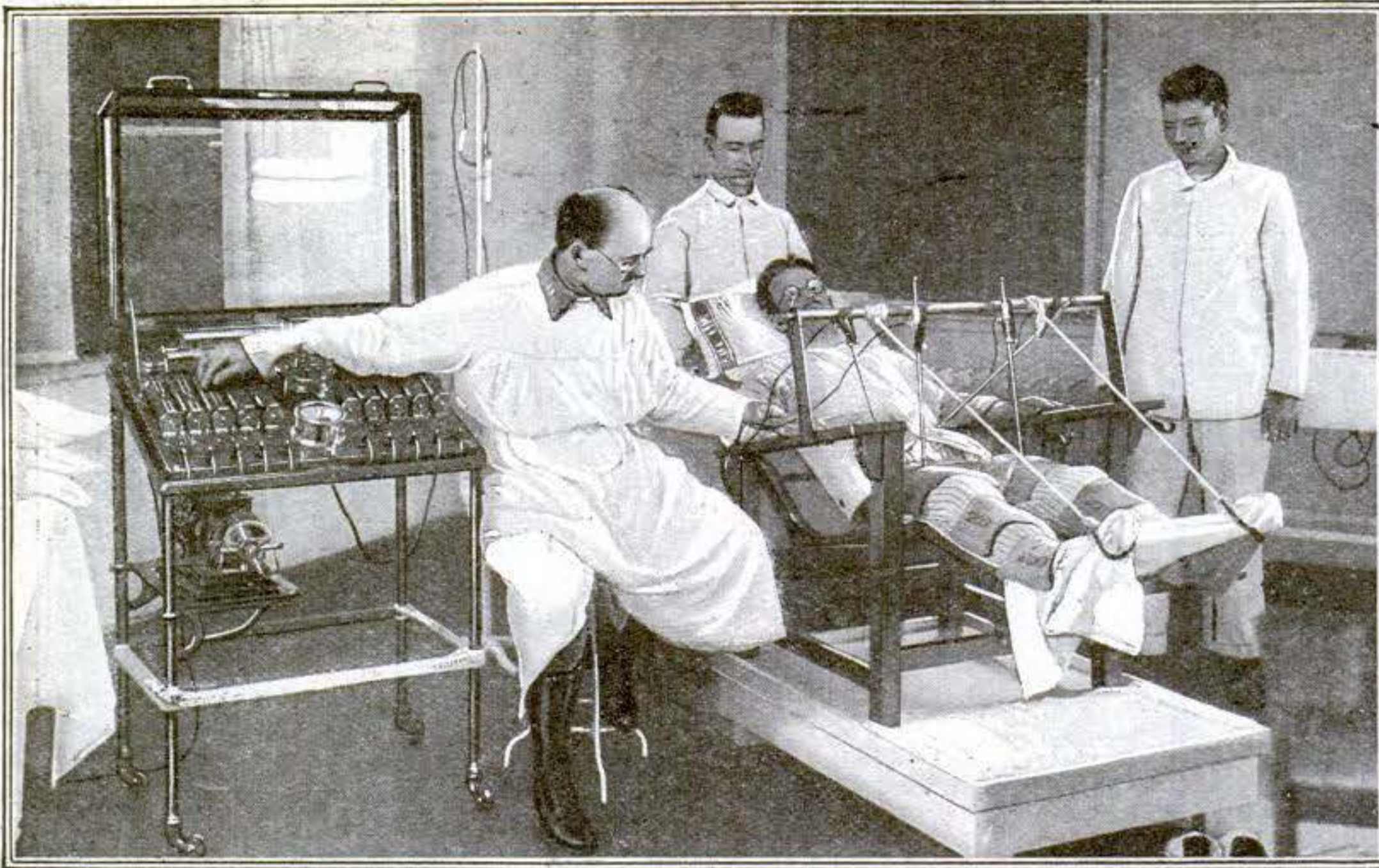
How is it known that the thyroid gland is responsible for these monstrous effects? Because the thyroid gland of sheep and cows has been fed with marvelous results to children who seemed destined to become dwarf-idiot. As if by magic, normal growth was resumed.

But what about giants? Their enormity is traceable to another body, called the "pituitary" gland, locked up in a mass of bone so deep in the head that there is not much chance of studying it. Your pituitary gland is not more than one third of an inch long. In a man eight feet three inches tall the gland measured just one inch.



The long fellow here is a Cashmeri 7 feet 9 inches tall. The dwarfs range from 36 down to 28 inches

© Underwood and Underwood



Before the war, fat millionaires and millionairesses used to go to Dr. Bergonie of Paris to have themselves reduced. Some of them could exercise but wouldn't, while others couldn't because of heart trouble; so Bergonie invented an electrical apparatus to twitch their muscles for them. Bergonie's invention now turns out to be a splendid means of curing shell shock

Curing "Shell Shock" with Electricity

IS shell shock a disease of the mind, or of the muscles, or of both? Physicians themselves do not know exactly what it is. But they do know some of its many manifestations—paralysis, St. Vitus dance, even insanity.

A physician who had used electricity successfully in civilian practice—Captain H. C. Westervelt, now attached to General Hospital 6—obtained permission to experiment electrically on cases of shell shock. He uses the Bergonie machine, named for its inventor, a Paris physician, who is a prominent member of the French Academy of Medicine. Dr. Bergonie utilized his invention several years ago in reducing fat and lazy millionaires and millionairesses to a semblance of fashionable slimness. What Bergonie did was to twitch their muscles electrically.

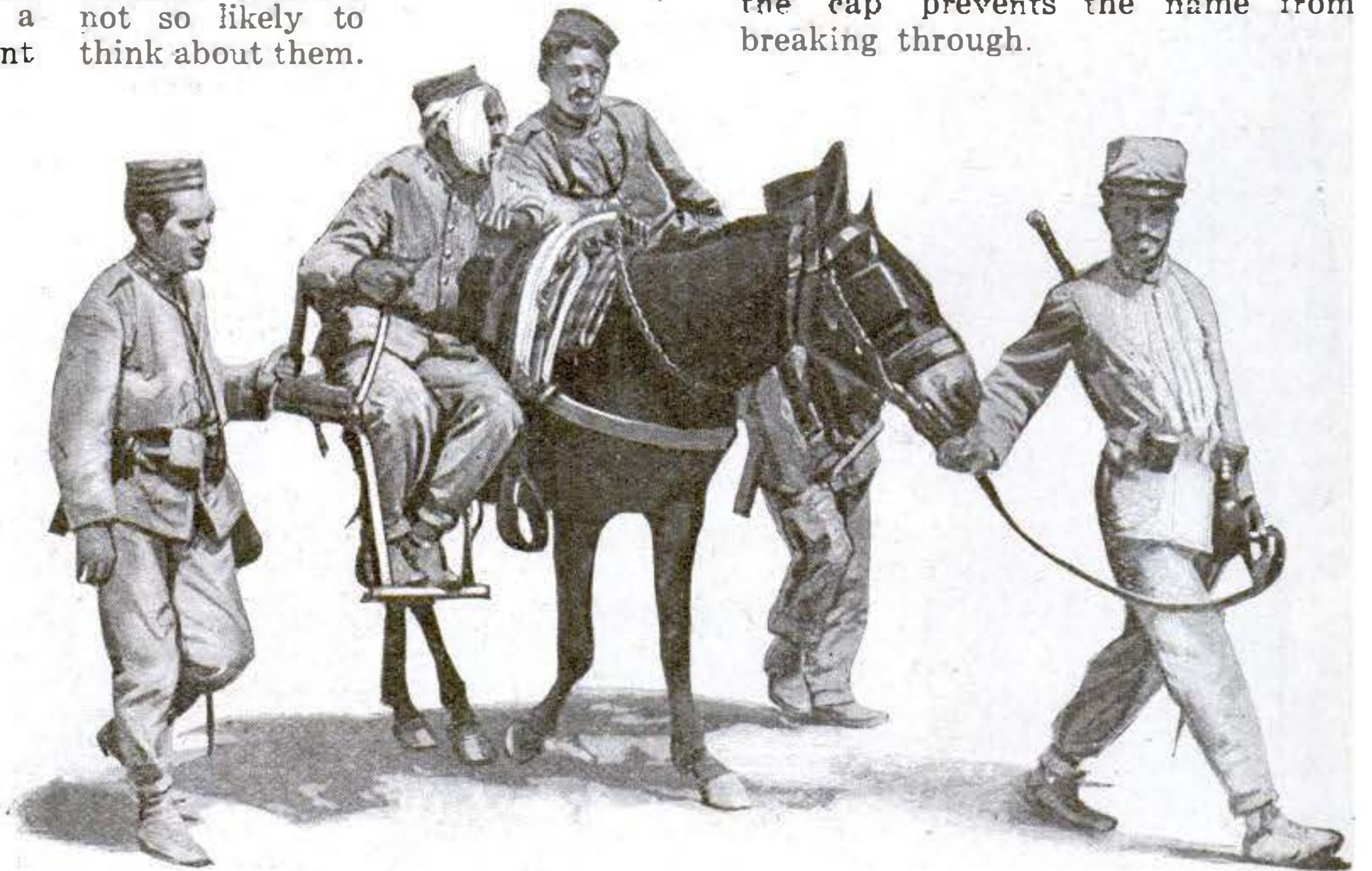
The Bergonie control board has twelve switches, corresponding with twelve motor points on the body which in turn control all the muscles of the body. Any part of a patient's body can be energized by the doctor at the board.

For instance, if a patient's legs are paralyzed, wet pads are placed around them, so that the water will conduct the current and his flesh will not be burnt. Electrodes are clamped to either side of the leg. The electricity is then turned on.

The flow of electricity is regulated so that the muscles relax and contract just as they do in voluntary exercise. After persistent treatment the patient finally

regains the use of his muscles; both his muscles and his mind are re-educated to perform the normal functions, the use of which have been suspended by the shock or the wound he has suffered.

Because the patient's mind must be kept occupied while he is taking the treatment, Captain Westervelt has installed a phonograph in the clinic. When the phonograph is telling you to "pack up your troubles in your old kit-bag," you are not so likely to think about them.



How the Turks Transport Their Wounded

In Turkey, where railways and automobiles are scarce, wounded soldiers are transported on the backs of mules or donkeys. A rude saddle-yoke is placed on the animal's back, with side seats to carry two men. Not very comfortable going over the rocky mountain trails, but better than nothing

Doughboy, Carry Your Stove with You

OF course you have seen the fireless gas-lighter. What is its secret? A small piece of platinum sponge, which has the curious property of absorbing and condensing many times its own volume of oxygen, so it will combine with other gases. The hydrogen in the gas combines with the oxygen in the platinum, and the heat liberated causes the sponge to ignite the gas.

This idea has been applied in a little stove for soldiers. A metal cylinder is packed with an absorbent material saturated with



benzine or kerosene. Over this fits a nickel-plated case, the top closed with a perforated disk covered with platinum sponge. The vapors of the benzine or kerosene cause the platinum to glow and ignite. The screen in the cap prevents the flame from breaking through.

Inventing New Flying-Machines

How the designer, with the aid of mathematics and laboratory instruments, evolves new types to outwit the enemy

By Ottorino Pomilio

ITALY was the first nation that used the airplane at all in war. That was in 1911, during the Libyan campaign in Africa. Aeronautically one-sided as that war was, it was of immense importance in the development of the military flying-machine. Whatever doubts there may have been—and there was enough ink spilled by army officers in military journals to prove that airplanes could never, never take the place of a reconnaissance in force—Europe knew that when the next war came it must reckon with the man in the air. Now, the Libyan campaign, although it taught many a useful lesson, did not by any means reveal all that would be required of a flying-machine in battle. No hostile airmen, no anti-aircraft guns molested the Italian scouts who flew over the hot sands of northern Africa and unerringly noted the positions and strength of the enemy. Rifle-fire alone was indulged in as an offset to aerial reconnoitering.

There was some Italian bomb-dropping—also very useful in the lessons that it taught. But no one could foresee that in 1915 men would be called upon to fight twenty thousand feet above the ground, that special machines would be required for reconnaissance and for bombarding, and that even a special kind of aerial tactics would have to be evolved to make the utmost use of an airplane.

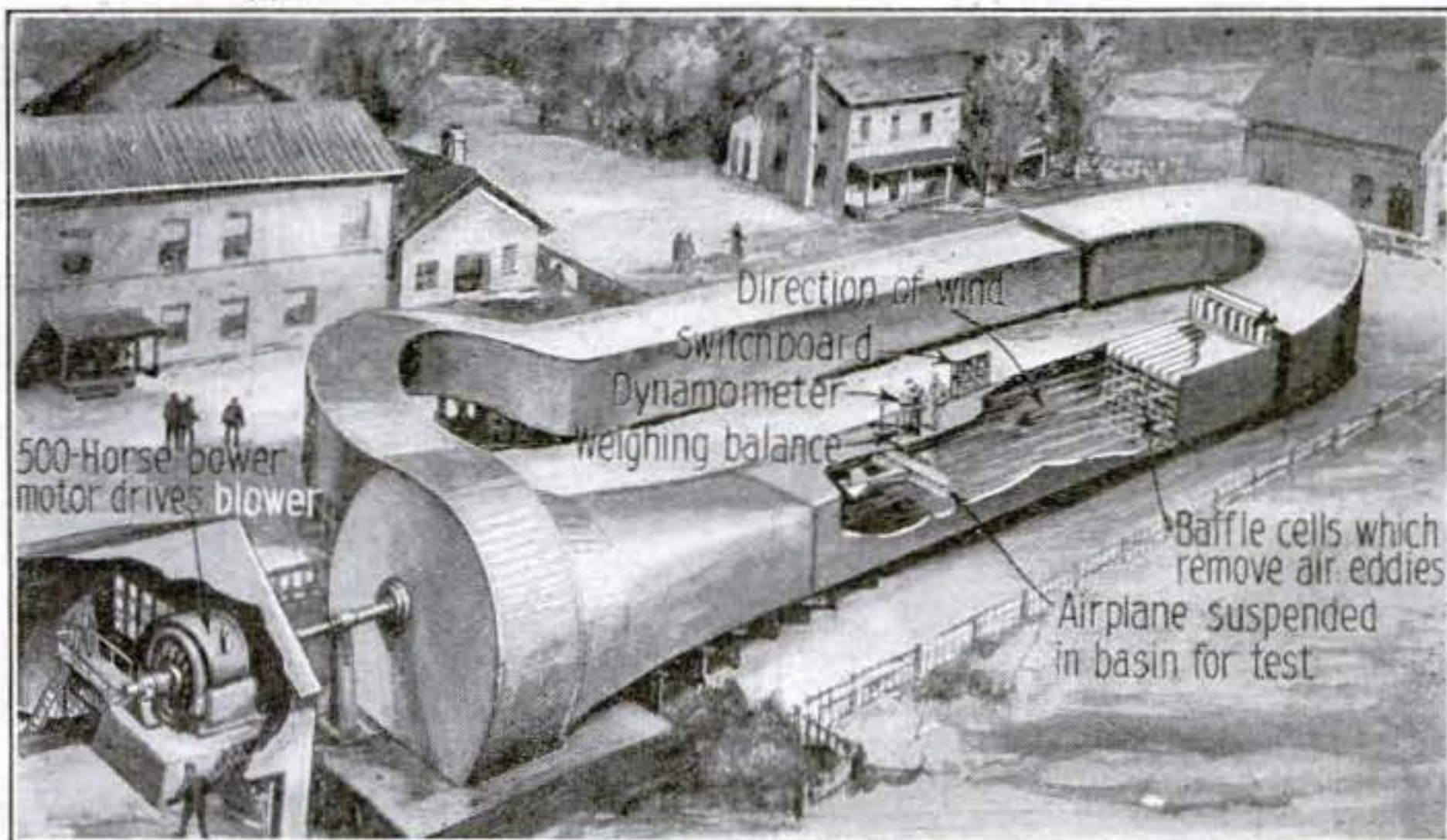
The machines used in the 1911 campaign bear only an outward resemblance to the machines in which the flyers of the Allies are now engaging the enemy. The airplane of 1911 was hardly the scientifically designed machine of today. Its engine was so untrustworthy that flights of two and three hours were extraordinary; its climbing powers were nothing to boast of; and its speed was scarcely sixty miles an hour.

The Scientist Enters

What a change there has been in a brief three years! In our factories we are building machines that it is confidently expected will make one hundred and



Ottorino Pomilio is one of the foremost aeronautical engineers of Europe, although he is scarcely twenty-eight years of age. A graduate of the École Supérieure d'Aéronautique of Paris, at the outbreak of the 1911 Tripolitan war with Turkey, Italy commissioned him to purchase flying-machines to be used at the front. Later he assisted in reorganizing the Italian aeronautic service. Busy though he was, he found time to write two important books ("Aviation Motors" and "Aeroplane Construction"), and eventually to build the famous Pomilio Aircraft Factory.



What is the best form of wing for a given type of flying-machine? Will it be strong enough to resist the air when flying at 120 miles an hour? The airplane designer must answer these questions. He secures his model rigidly in a tunnel; then he blows air against it, to see what resistance it offers

eighty miles an hour. Our bombing and reconnaissance planes are now faster than the fastest fighters of 1916. Our engines may be depended upon to drive airplanes through the air for many hours.

This almost breathless progress is due entirely to science. The blacksmith and the carpenter who built the machines of the daring pioneers of 1909-1912 have made way for the

engineer and the mathematician. Rule-of-thumb has given place to mathematical formulas; guesswork to absolute knowledge.

A flying-machine is not merely a thing of linen, spruce, and steel. It is in very truth a wonderful artificial bird. Like a bird, it has a body—its fuselage; like a bird, it has a heart and lungs—its engine; and, like a bird, it has brains—its pilot. The flying-machine differs from the bird only in that its various parts perform special functions. The engine of a flying-machine, for example, supplies only propulsive power; the heart of a bird, on the other hand, must also keep the blood in circulation.

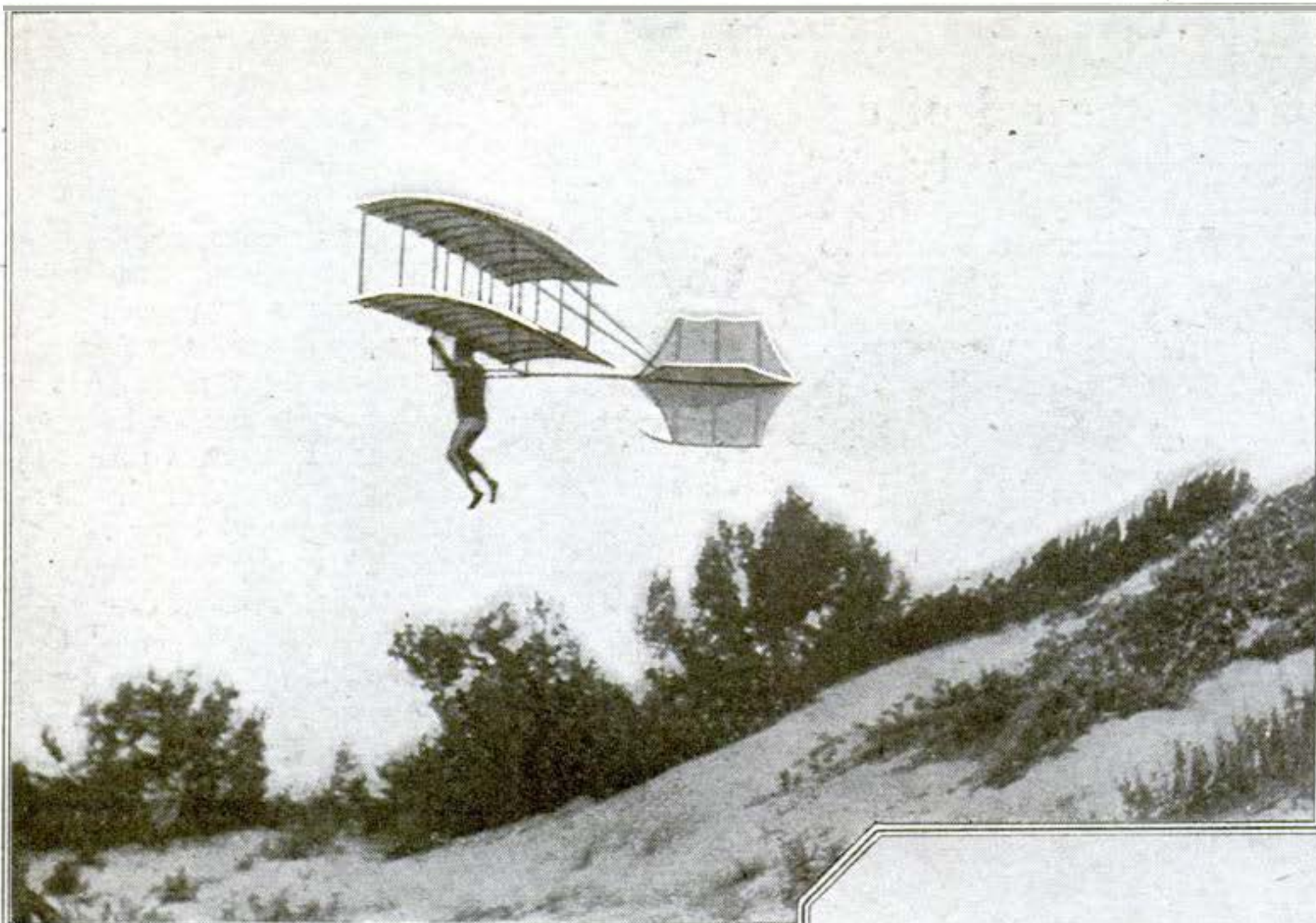
How He Approaches His Problem

A flying-machine is conceived by a modern designer primarily as an engineering structure. The speed it is to make, the load it is to carry, the ease with which it is to be maneuvered—all are carefully computed.

To create a new type of flying-machine, a designer may proceed in one of two ways. Which-ever way he may decide to adopt, the horsepower at his disposal is his primary consideration. One method may be termed analytic, and the other synthetic.

Suppose that a flying-machine must be built to carry a certain number of passengers, a certain number of guns, a certain amount of ammunition (machine-gun bullets and bombs), and fuel for definite number of hours.

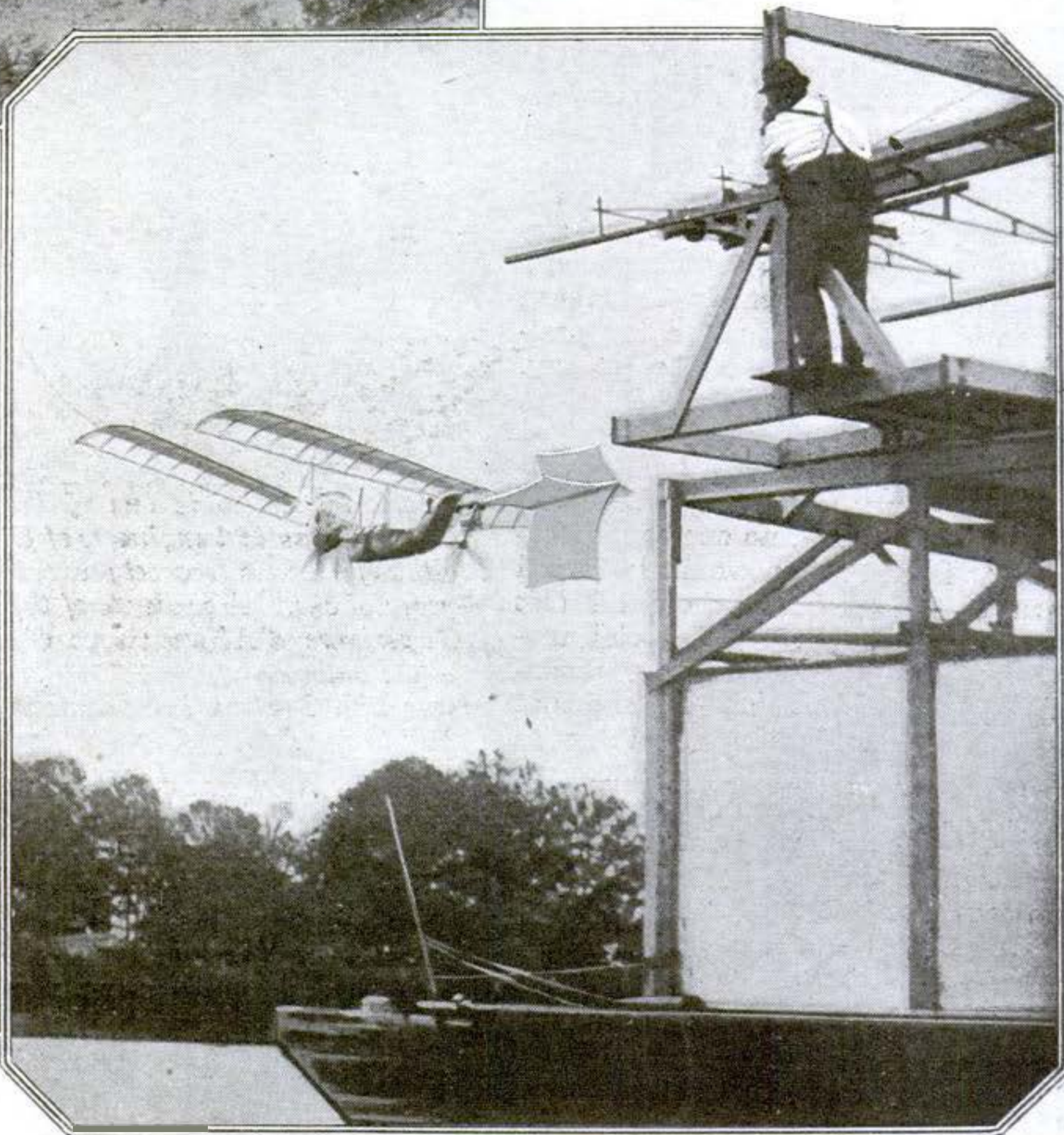
(Text continues on page 36)



Otto Lilienthal was an engineer who began his gliding experiments in 1891. His apparatus was merely a rigid pair of wings. As the picture shows, he would grasp the handle-bar; run down a hill, and then draw up his legs. Thus he was able ultimately to fly several hundred feet. Eventually he built this biplane glider. Because the wind blows in gusts and never in a steady stream, the "center of pressure," as the scientists say, was constantly changing. Hence, to maintain his balance, he had to throw his weight from side to side. In 1896, while testing a glider in which he intended to mount a motor, he lost his balance and was killed.

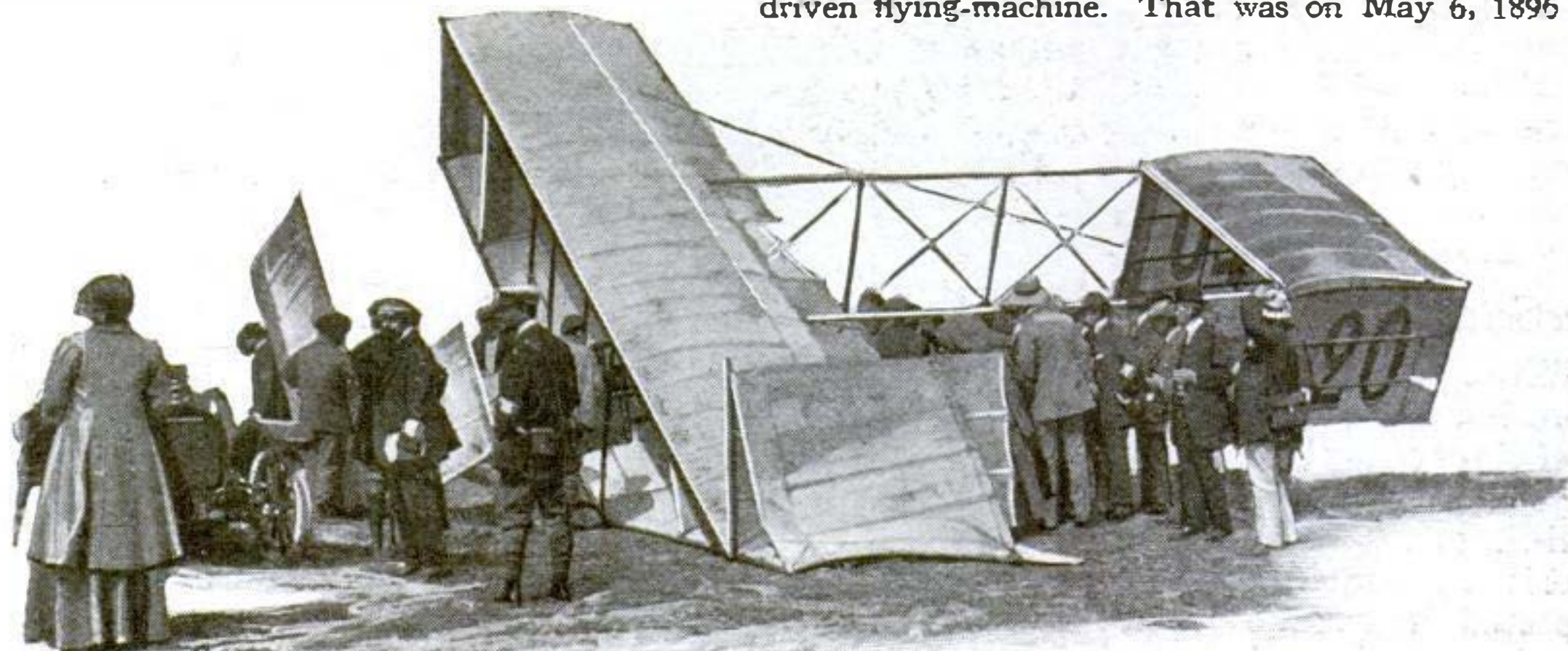


In such a machine the Wright Brothers taught men how to fly. Modern machines are very different, but the art of flying as the Wrights taught it has not changed.

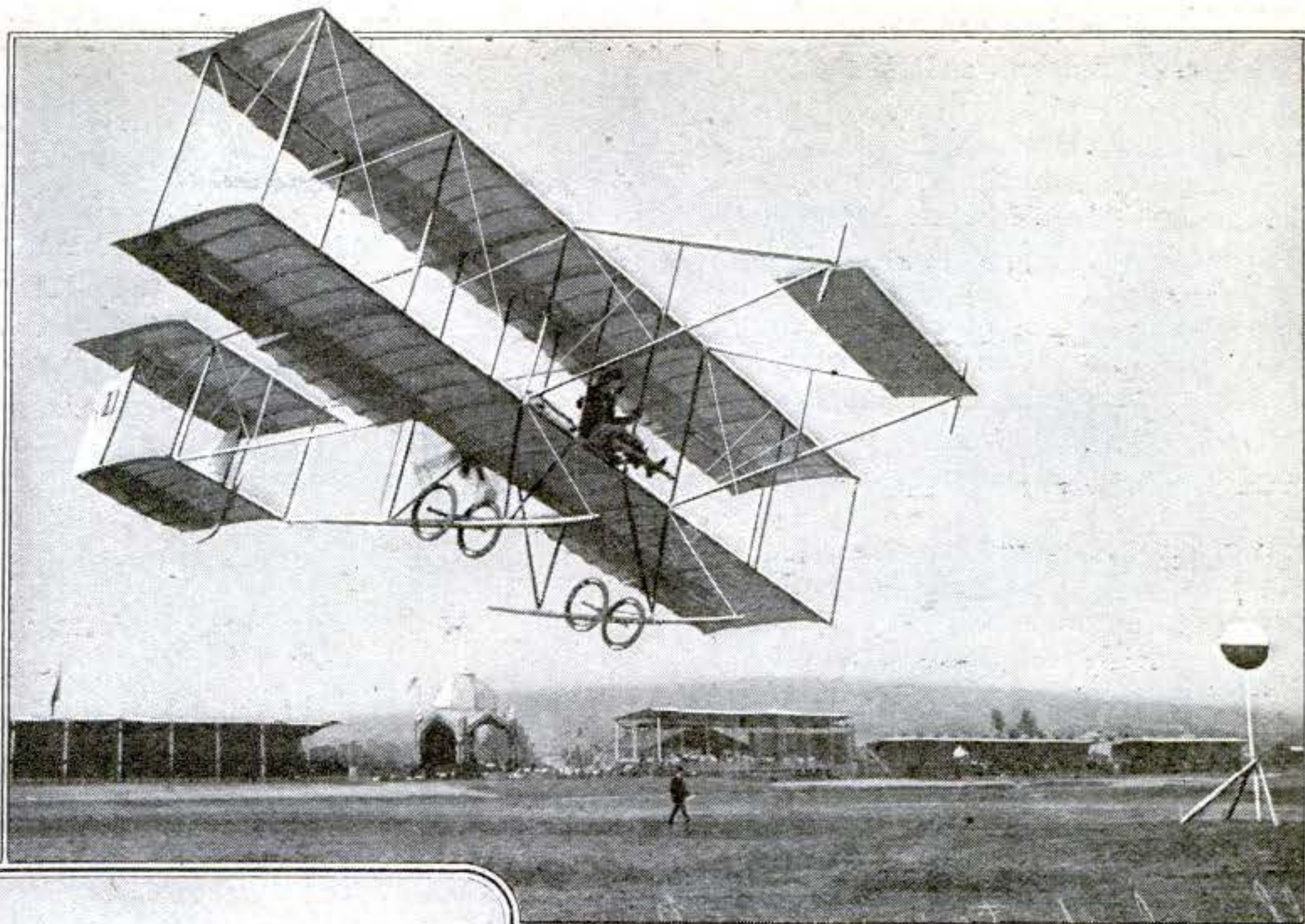


Everybody used to laugh at Samuel P. Langley. For all that, he was the first man to fly a motor-driven flying-machine. That was on May 6, 1896.

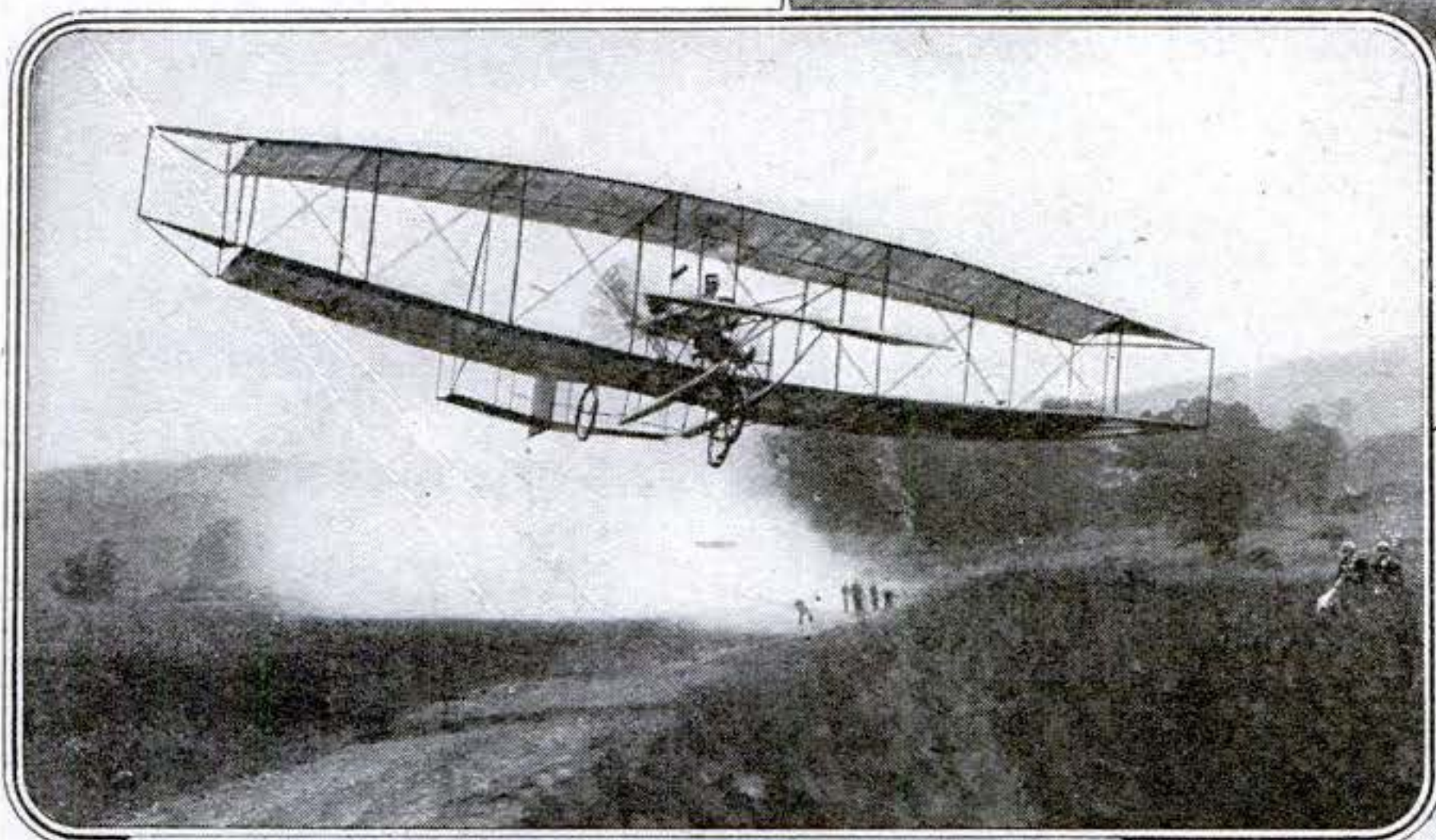
Away back in 1908, before the Wrights came out into the open, Voisin in France made machines in which a few enthusiastic Frenchmen risked their necks. There was nothing to prevent side-slipping except a few vertical partitions between the wings, partitions that were supposed to offer the necessary resistance but didn't, as this historic photograph abundantly testifies. Voisin is still in the airplane business, but he now builds machines that can fly in any weather.



After the Wright Brothers went to Europe and showed the world how to fly, Henry Farman abandoned the crude boxlike Voisin in which he used to fly when there wasn't a breath of air stirring. He frankly copied the Wright machine in its essential features. Here is his 1909 machine. Nowadays the aviator sits comfortably in a beautifully modeled boat-shaped body that offers little resistance to the air



After the Wrights came Curtiss in 1908 with this machine. Wings are not arched in this way nowadays; it's inefficient to do so. The little triangular terminations to the wings are the ailerons, or flaps by which side-to-side balance was maintained



Louis Blériot was a manufacturer of automobile lamps who had tried hard to fly ever since 1900 and smashed machine after machine before the Wright Brothers vaulted into the air in France. He watched them, saw why he was making little progress, and built a monoplane (here it is) in which he flew across the English Channel on July 25, 1909. He made about forty miles an hour; now one hundred and twenty is considered about right for a fighter

When Henry Farman took these three passengers up with him in 1909, the world voiced its amazement. Only recently the giant Handley-Page flew with twenty-one, and no one batted an eye. Few of the present flyers would risk their lives in this flimsy machine. They would not mind seeing the ground between their legs five thousand feet below, but they would mind the unscientific and weak wings. The air resistance was so great that forty miles an hour was the best to be hoped for with such a machine

(Continued from page 33)

Suppose, in addition, that the machine must have a definite climbing and horizontal speed.

Given such a machine to create, the designer must determine the minimum amount of power required to get the best results; in other words, he must choose the most suitable type of motor. Hence I call this the analytic method of designing.

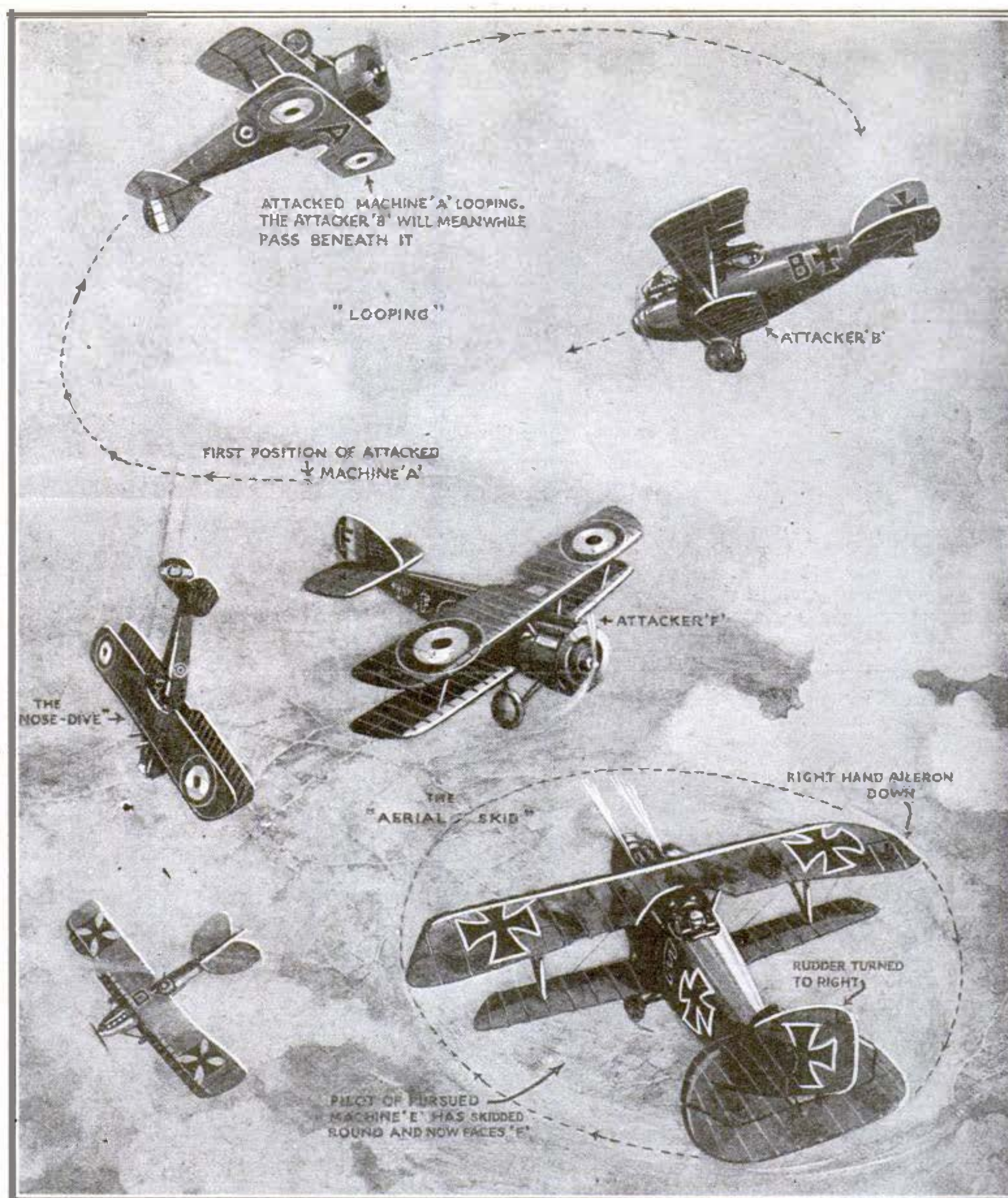
Airplane Problems

But suppose—and this is the usual case—the designer is given a certain engine with which he is thoroughly familiar. Around that engine he must drape, as it were, a machine that will carry a certain load of passengers, armament, and ammunition and fuel for a flight of a certain duration. This I term the synthetic method of designing.

In either case, however, the designer must discover the best climbing and horizontal speed obtainable with the material and machinery at his disposal.

Although there is no hard-and-fast rule to govern the choice of the various elements of which a flying-machine is composed, nevertheless limits are imposed beyond which the designer may not go without fantastic results.

For example, suppose he is asked to create an airplane that will have a speed of three hundred miles an hour, maintain that speed for a flight of from four to five hours, and carry fuel enough for so long a journey, besides three passengers. Such a machine would require an engine of several



When Pégoud first looped-the-loop, the world gasped, but it also wondered what was the good of it. The value of such maneuvers is evident

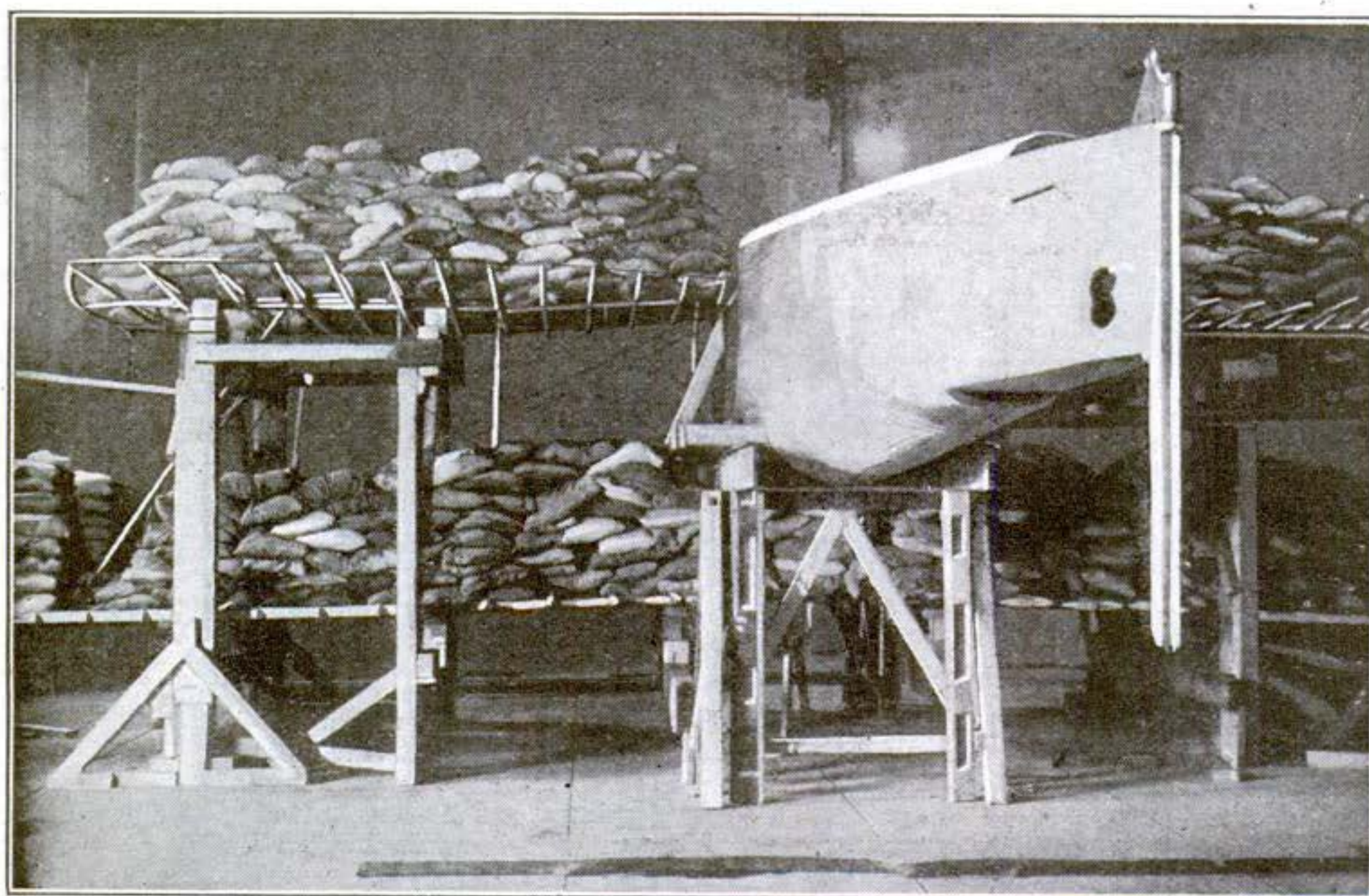
thousand horsepower—a wild absurdity at the present time, because the engine required has not yet been constructed, although there is no doubt that it will ultimately be developed.

Reducing Air Resistance

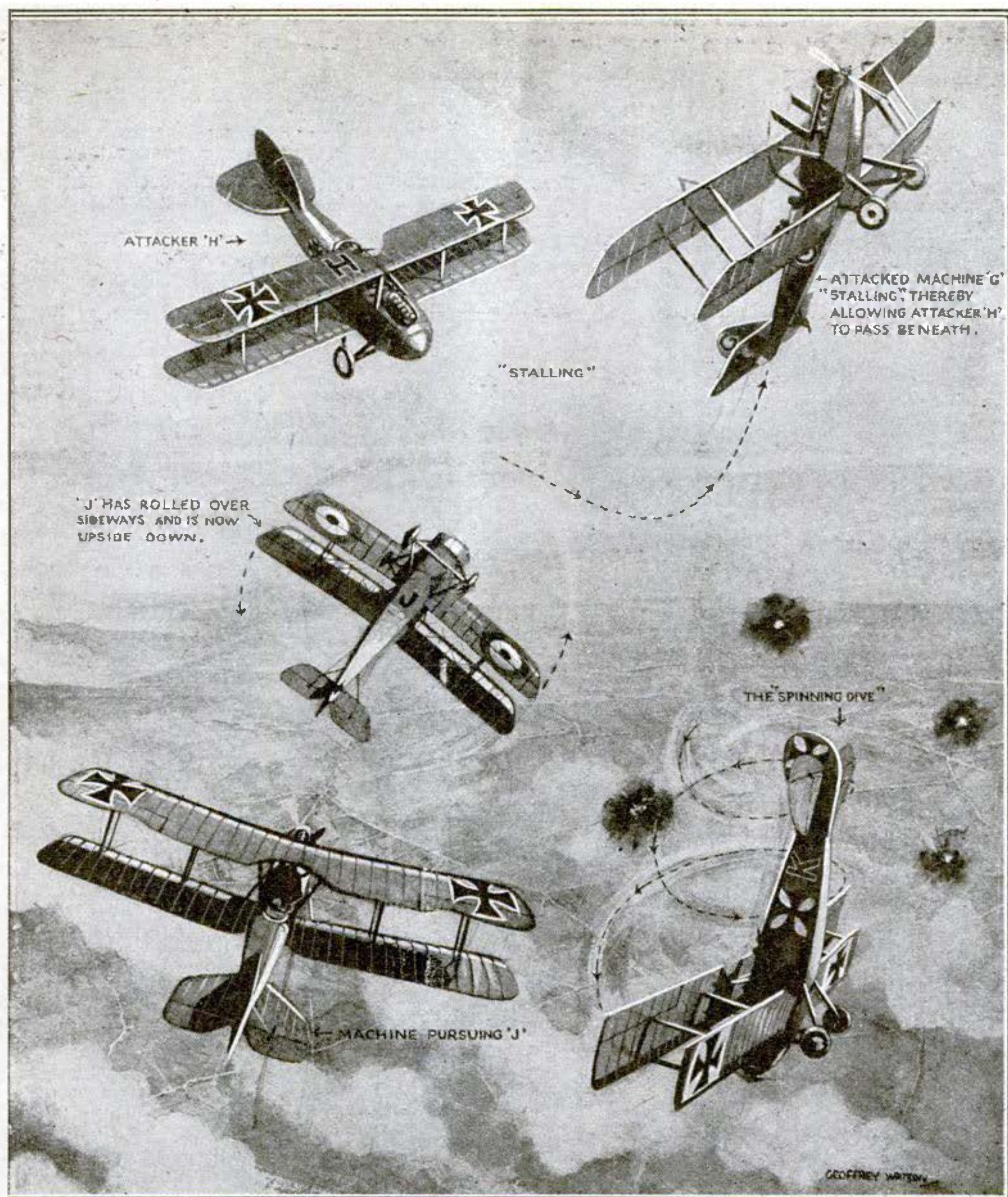
We all know how important is fineness of line in building fast transatlantic steamers or torpedo-boats. The hull must be so shaped that it parts the water easily. So, likewise, the flying-machine must part the air with the least possible resistance.

In a sense, it is easier to build a fast steamship than a fast flying-machine. The steamship, after all, is a single huge hull. On the other hand, the flying-machine has not only a hull (its fuselage, in which the pilot sits), but a vast expanse of wing, with its struts and wires.

An airplane is essentially a structure of surfaces—useful surfaces and parasite surfaces. As anyone can guess, the useful surfaces are



A flying-machine is supported by the upward pressure of the air against its wings. The wings must withstand the blows of the most violent storm. To find out whether they are strong enough, the maker turns the machine upside down and loads the under side of the wings (now turned up) with sandbags of known weight, until a few handfuls of sand cause the wing to sag



in the present war. Every aerial fighter must be an acrobat now. He twists and turns, side-slips, and performs a dozen evolutions unknown to Pégoud

the wings that support the structure in flight; the ailerons, or controlling flaps, which maintain balance from side to side; the elevator; the rudder; and the fixed tail. The parasite surfaces are the fuselage, or hull, to which the main wings are attached and in which the pilot sits; the struts and wires necessary to hold the wings together; the landing-gear; the radiator; etc. The best flying-machine is obviously that in which the amount of parasite surface is reduced to the minimum.

It might be supposed that the experiments made by Langley, Eiffel, Prandtl, and other physicists answered once and for all the question: What is the most efficient curve of wing? Eiffel and others studied the effect of the wind on small model airplanes in elaborately constructed wind-tunnels; but their findings hold good only for the particular models studied. Supposing that I design a different landing-

gear or a different form of wing. I must still conduct tests with models to ascertain whether or not I have made any substantial improvement.



Here are the biggest and smallest machines. The big machine is the bomb-dropping Handley-Page; the small one a 125-mile-an-hour fighter. It might be supposed that the big machine is nothing but an enlargement of the small one. But the wing curves are different in order to secure lifting capacity in the big and speed in the small machine

Hence a designer is dependent on a well equipped aero-dynamic laboratory.

In a wind-tunnel provided with the most precise measuring instruments, a model is placed, one hundredth as large as the actual machine that is ultimately to be made. In the wind-tunnel the efficiency of the proposed construction is very accurately ascertained. If the results at first obtained are not satisfactory, the model can be changed, although the mathematical investigation that has preceded its construction is usually so accurate that changes are never very radical.

Importance of the Wing Curves

If a flying-machine is to rise from the ground at all, it must have the proper curve of wing. Hence, the designer concerns himself more with the wing than perhaps with any other one feature of the machine. On the whole, the curve adopted usually resembles that to be found in the wing of a flying bird. The top of the wing is convex, the bottom concave. Like a bird's wing, its greatest thickness lies near the point of attachment to the body; it becomes thinner near the extremity.

The painstaking studies that were made of birds' wings have served their purpose; for most of the successful flying-machines of today have wings which, aerodynamically considered, are derived from those of a bird.

There are as many varieties of wing curves for airplanes as there are for birds, and each serves its own function. The properties of each curve have been very carefully determined in the wind-tunnel, so that a good designer can select that curve which gives him the maximum amount of support and the least head resistance for the particular type of machine on which he happens to be working.

Wind-tunnel experiments have shown that exaggerated curves are not conducive to high speed—indeed, that they are best for slow-speed

machines. Moreover, they have also shown that trailing edges must be very sharp.

Testing a Model with Sand

Having scientifically determined what form he will give his craft, the designer proceeds with the construction of a full-sized machine. This is all the more important in the building of military machines in which the problem of armament must be considered. Guns, bomb - dropping devices, cameras, wireless apparatus—all offer a certain amount of head resistance. This head resistance must be reduced to a proper disposition of the devices named before the factory can begin to build the machines in quantities.

The designer must find out exactly to what extent its wings can be loaded. What is known as a "static" test is therefore conducted, the purpose of which is to confirm the original mathematical calculations, and to enable the designer to correct unavoidable errors in computation. In what does the static test consist?

The machine is turned upside down, and bags of sand, weighing about a hundred and twenty pounds each, are placed upon them. At last a dramatic moment is reached, when a few handfuls of sand, added to the load already imposed, cause the wings to sag.

And now comes the tense moment when the scientifically conceived and carefully tested machine is to be flown for the first time. The pilot—a man picked not only for his skill as an aviator, but also for his intimate knowledge of the mechanism of a flying-machine, climbs over the cowl

and belts himself into the seat. A mechanic gives the propeller a twist. There is a roar. The machine bounds over the grass like a living thing.

Satisfied at last that he may trust himself to this pulsating thing of pistons and cylinders, the pilot turns his elevator ever so slightly. The machine leaps into the air and soars up and up into the blue. In half an hour

(1) defects of centrage; (2) defects of control; (3) defects of secondary importance.

It is difficult to determine in a flying-machine what is the exact location of the "center of pressure"—the theoretical point in which the entire force of the air, as the machine rushes on, is supposed to be concentrated. The fault is not easily corrected; for it

means that the curve of the wing is not what it should be.

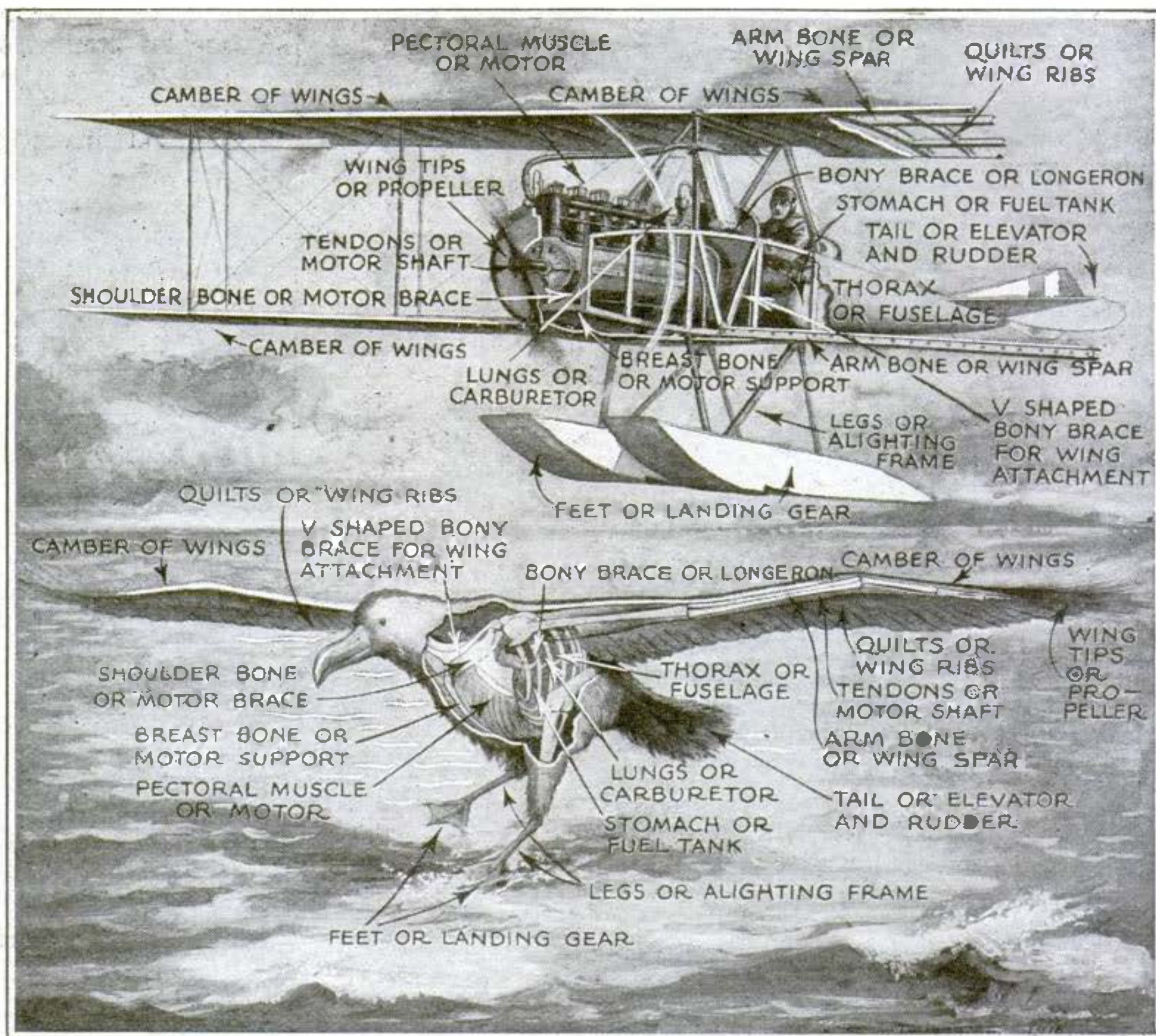
On the other hand, the second class of defects (defects of control) are easily corrected by a displacement of the wings relatively to the fuselage, or by shifting the masses in the fuselage (guns, wireless outfit, etc.); or by varying the surface of the fixed horizontal tail.

Those defects of secondary importance which constitute the third class are more easily foreseen by the experienced designer. They are occasioned by the influence of the various parts of the machine upon one another. Thus, the blast of the propeller as it is deflected by the machine itself may react in an undesirable way on the wings or the fuselage.

An astute pilot, who becomes as much an integral part of his machine as a cavalryman of his horse, may be of the utmost assistance to the designer. Preferably he

should be a man who has had much experience in the air over the battle-field.

But it must not be supposed that the pilot indulges in but a single flight. He goes up time and time again, each time reveling in some new acrobatic trick of the expert pilot. Unless a machine can loop-the-loop, spin down nose first, and even fly upside down for a time, it cannot be used in an air duel.



There is more than an external resemblance between the airplane of to-day and a representative bird. The chief parallel is found in the fact that in full flight a large bird does not flap the central part of its wings, but forces itself through the air with more or less fixed wings at a slight "angle of inclination," deriving support exactly as does an airplane, from air pressure. Also, that it flaps the tips of its wings not for support, while doing this, but for propulsion, which it derives by automatically "feathering" them like a sculling oar. The only difference between the wing-tips and the screw-propeller of a flying-machine is that the rotation is reversed continuously, long before a single circle has been completed. Another striking likeness is in the location of the bird's motor (its pectoral muscle) right in front, as in an airplane, and the nourishing of this muscle by the digestive organs and the lungs, much like the feeding of a motor from fuel-tank and carburetor. The electric ignition of a flying-machine, again, closely resembles the incitement of a muscle by the motor nerve. Other parallels between natural and artificial flight become obvious from the accompanying drawing, contrasting an albatross with a seaplane.

he knows all the tricks and all the whims of that new machine.

The Airplane Finds Itself

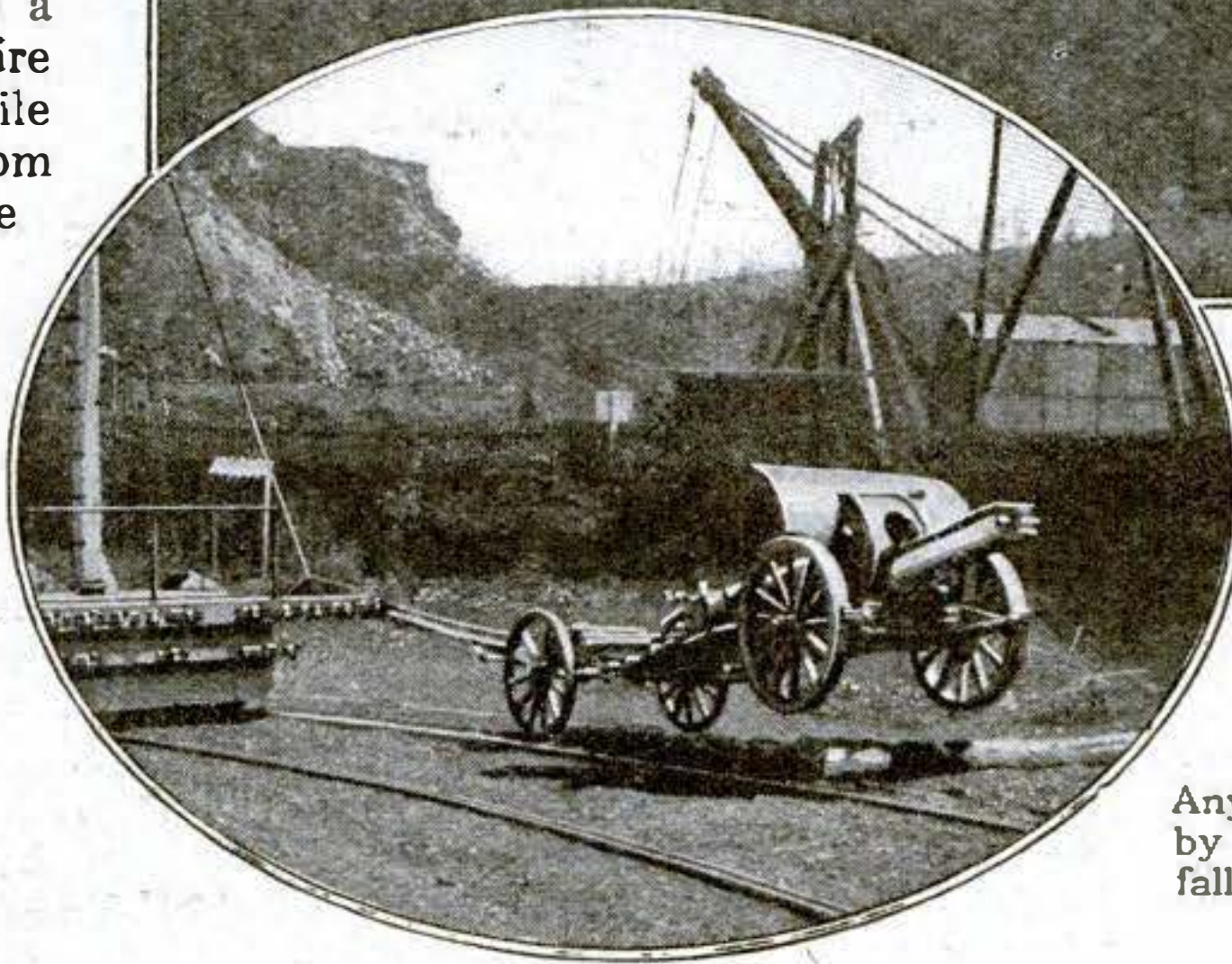
The pilot assures himself that the machine is as practicable as possible, and that the cock-pit is as comfortable as one may expect of a war machine. He drops to earth in a glide or two, and makes his report. The defects to which he calls attention are:

Those of us interested in science, engineering, invention form a kind of guild. We should help one another. The editor of the POPULAR SCIENCE MONTHLY is willing to answer questions.

Shooting Barbed Wire Out of a Mortar

WHEN barbed wire was invented it was for a strictly peaceful purpose, and nobody dreamed that it would ever gain prominence in the bloodiest war in history. Yet, ever since the Boer War, barbed wire has taken its place among weapons of defense.

The illustration below shows a device for utilizing barbed wire to impede the advance of hostile troops. It is a mortar from which five rolls of barbed wire are fired simultaneously. Each roll is wound around a hollow steel core filled with an explosive. The charges communicate with a priming charge, which is exploded by a percussion cap. The projectile is fired 200 feet in the air. When it strikes the ground the charges explode, releasing the wire.



A modern field-piece must not only be able to shoot straight and far—it must also be light, so that it can be hauled easily over rocky country. But how light? To answer that question is the object of the test through which the makers of the French "75" are putting that famous weapon

Any gun that can stand this can be jerked by galloping horses over boulders and fallen trees without breaking apart

How the Guns Are Made to Bump the Bumps

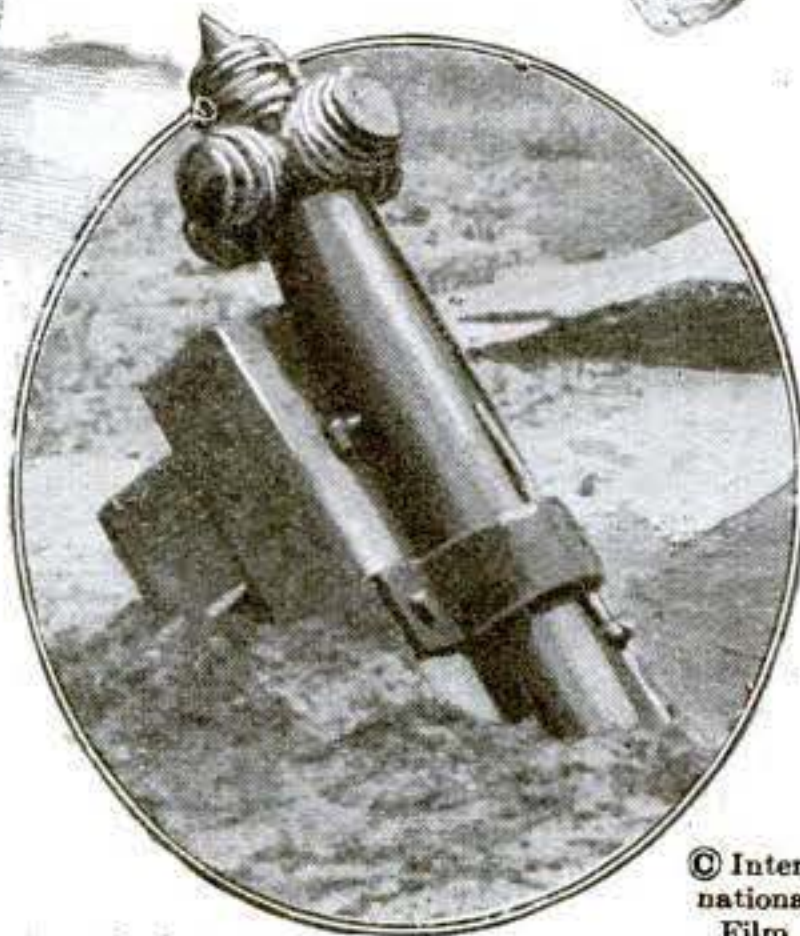
WHEN a civilian sees a gun he is sure to ask, "How far will it shoot?" To be sure, this question must be considered when a gun is designed. But the commander of a battery of field artillery is more apt to ask, "How much does it weigh?"

He knows that he would not be given a piece of insufficient power, but he is not so sure that it can withstand the grueling tests to which it must be subjected when he must advance over rocky and hilly and muddy ground in pursuing a fleeing enemy.

A good field-piece must be as light as it can be made, and yet it must be so strong that it can be hauled at a gallop over boulders without deranging its mechanism. Many differences to be noted in the field-pieces adopted by the warring powers are to be traced to this effort to obtain great hitting power (which means weight), staunchness of construction, and lightness. The power of the gun is limited by its weight, and this is limited by the load that a team of six horses can pull at a trot.

To find out how staunch is the construction of a gun, every army conducts tests far more searching, in all probability, than those of actual battle. Thus the French "75," considered by far the best field-piece in existence, is tested at the famous French works of Creusot by hauling it over logs and railway ties behind a locomotive. The gun, with its wagons and limbers, bounces into the air as each obstacle is struck, and comes down with a crash that ought to shake loose every bolt and break every axletree. The gun comes out of the test none the worse for its experience.

The railway-tie method of testing field artillery has the advantage of saving time and labor. Two, even three, guns at a time can be hauled behind the tireless locomotive, so that an elaborate test can be made by a few highly trained men.



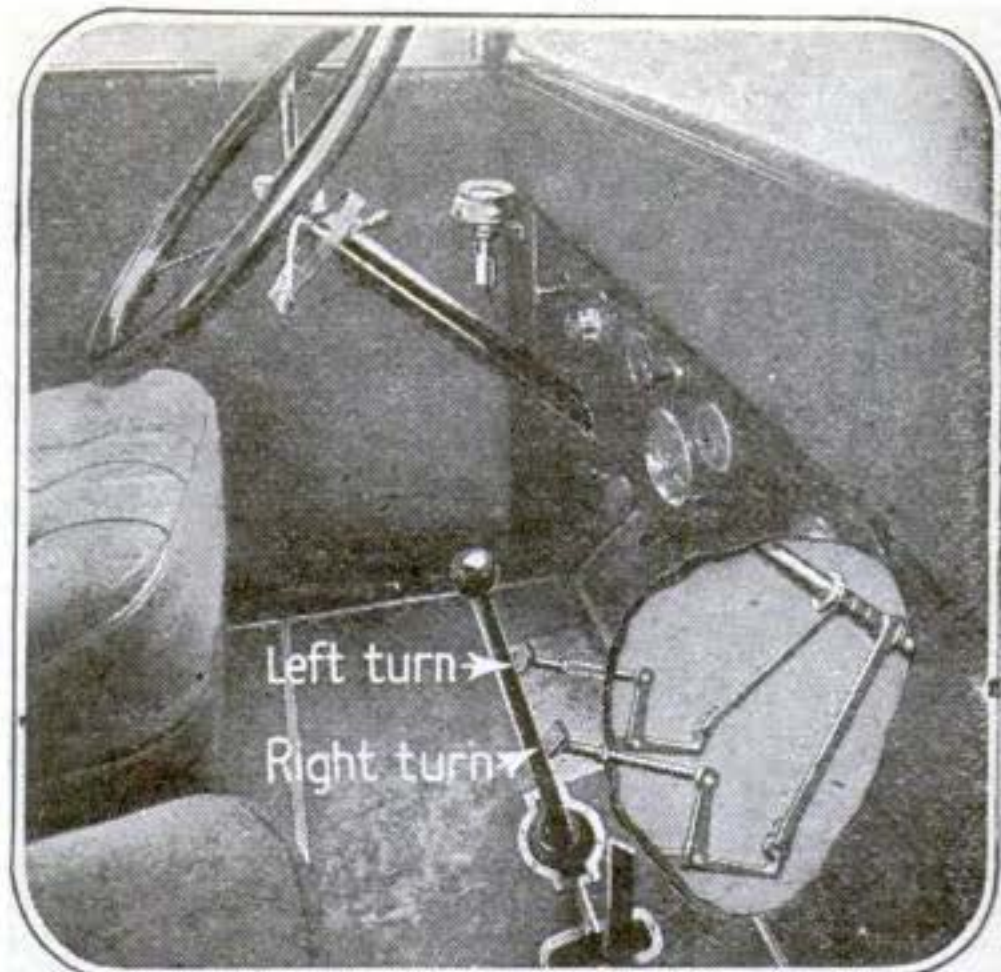
© International Film

You've seen a spider throw an entangling web? This is a mechanical spider—a mortar that throws a projectile carrying five rolls of barbed wire at the enemy. Exploding when it strikes the ground, the projectile releases and spreads the wire, harassing and impeding the approaching enemy



Glaring headlights do not annoy this motorist. The dark shields absorb the rays. The clear glass permits him to see the road

A Texas man's foot-steering contrivance, releasing the hands for important tasks



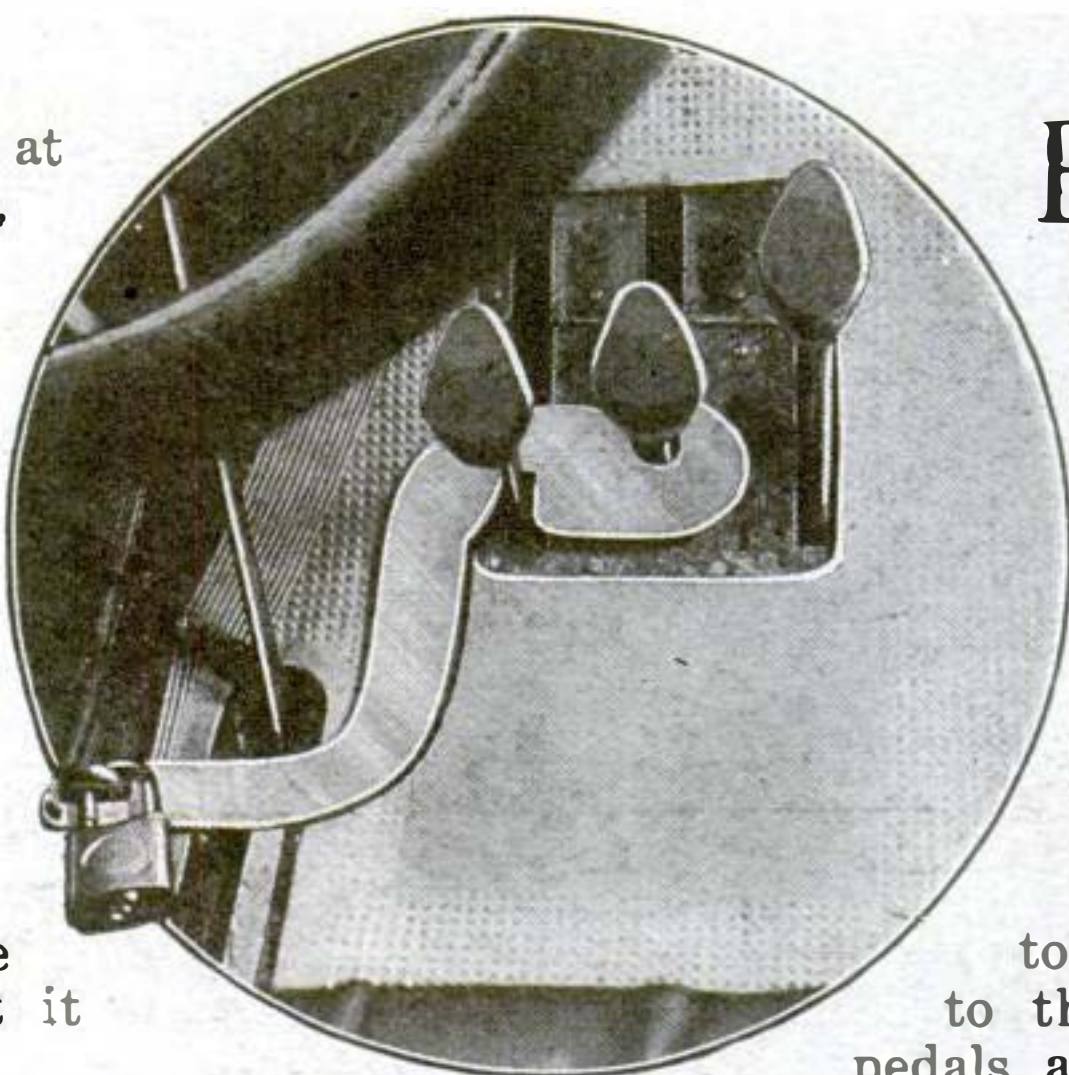
Making the Night Safe for Automobile Drivers

WHEN a polite motorist driving at night meets another automobile, he instantly switches off his headlights. But, just as street-cars have developed the voracious seat hog, so have automobiles produced the headlight hog.

He is a menace. No greater nervous tension and actual fright can be packed into a few seconds at night than that occasioned on an unseen road by the blinding glare of a car in the hands of a reckless driver.

To take the curse from the menace of the headlight hog, cunning goggles have been devised, with the left side of each lens colored darkly, so that it appears to be going into an eclipse.

When blinding headlights approach, the wearer of the goggles merely turns his head slightly to the right. The dazzling rays are absorbed and nullified by the dark segments, leaving the clear part of each lens available for studying the road.



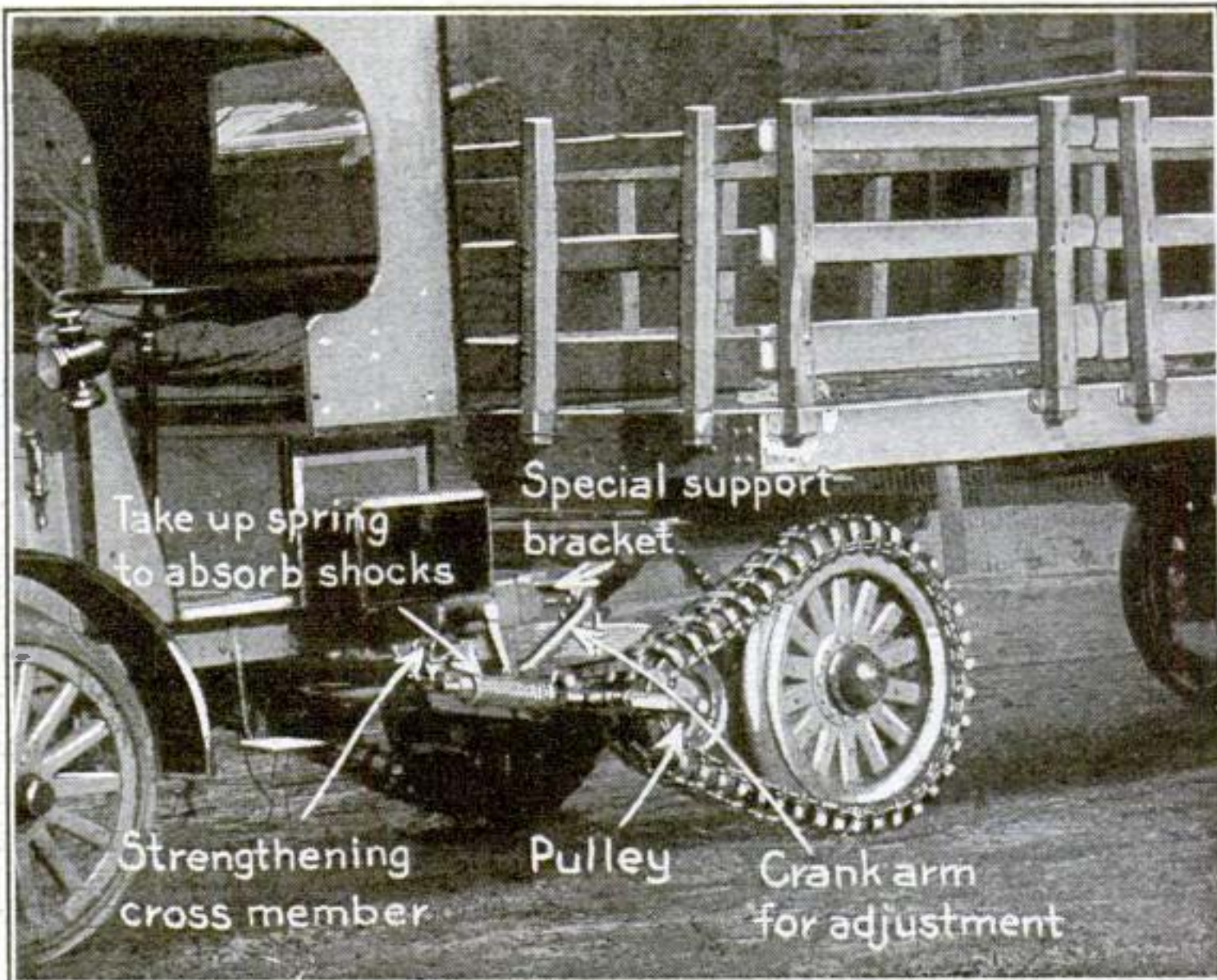
See the S-shaped bar and the notches into which the reverse and high-speed pedals fit? It foils the auto thief

Lock the Pedals of Your Ford and It Can't Be Stolen

ANYONE will tell you that you cannot run a Ford backward and forward at the same time. This is what a thief would have to do if he stole a Ford equipped with a new type of pedal lock. It consists of an S-shaped flat bar of iron with a slot at one end to fit over a U-bolt driven into the floor of the car, and two notches at the other to contact with the supports of the high-speed and reverse pedals.

When this bar is slipped into place and locked with a padlock slipped through the U-bolt, the other end of the bar forces both the high-speed and reverse speed bands into play. This effectively prevents the movement of the car, even by towing.

Picking the padlock is the only way to nullify the purpose of the device; for the bar is heavy enough to prevent filing or chiseling.



A Belt that Will Prevent Motor-Trucks from Skidding

AN entirely new type of non-skid device for motor-trucks is an endless belt of U-shaped metal parts. The belt fits entirely over the tread of the tire.

The front or forward end of the belt is carried over a special pulley supported from the tractor chassis a short distance in front of the rear wheels.

The shaft of the pulley is carried on a crank-arm, so that it may be moved backward and forward and then locked in place to fit a particular truck.

A spring is also used to take up any shocks that are transmitted to the driving wheels, so that the belt will not jump off the tire tread.

The endless belt prevents skidding. It fits over the tread of the tire, and can be adjusted to fit any motor-truck. A spring takes up any shocks transmitted to the wheels

How Are We to Keep Warm This Winter?

BUT one fuel can successfully take the place of hard coal, and that fuel is coke. By coke we do not mean the ordinary gas-house coke that has so often been used, unscreened and unprepared in any way, but a domestic coke, made by a special by-product process, screened and assorted in sizes like hard coal.

What Is Coke?

Coke is the coal that is condensed by a special process to a form approaching, as nearly as possible, pure carbon, and that is further made more combustible by its light and porous structure. It is the solid part of the coal left after the volatile matter has been driven off.

In distilling by the retort-oven method, coal is placed in a closed chamber heated by the combustion of gas in flues, arranged in the wall of the chamber. In such a chamber the highest grade of coke possible is produced, and all the by-products that rise in the form of vapors are recovered.

The heat-producing qualities of coke surpass those of hard coal. A ton of coke can be made to go further than a ton of hard coal, because it is pure fuel, contains less waste, less incom-bustible material, and about one third as much ashes.

How to Use It

A coke fire will "come up" more quickly in the morning than a hard-coal fire, at the same time holding just as well overnight; it is all a matter of damper adjustment. Then, too, coke can be stored out in the open better than any other fuel, and handled without depreciation. It is clean; for there are no clinkers.

By B. Kaye

A coke fire must be checked to keep down the heat; a hard-coal fire must be poked into activity. A great deal depends on how the fire is kindled, but once the fire is started, coke burns hotter and faster than coal does. Care should be exercised in regulating the draft, for a beginner often blows out his fire before it is well started.

To start the fire, kindle it as you would hard coal; but, as fast as flames appear, cover them with smaller pieces of coke, thus closing in the heat and deepening the bed of coals. This is important. Coke kindles best from its own heat.

What to Remember

When the fire is once started, shut off all drafts, especially chimney draft, to keep the heat from going up the chimney.

Do not shake or poke a coke fire half as much as you would a coal fire.

Keep the bed of the fire deep, with coke well piled up.

Remember that a large body of coke, burning with a gentle glow, will give more heat than a small quantity burning fiercely.

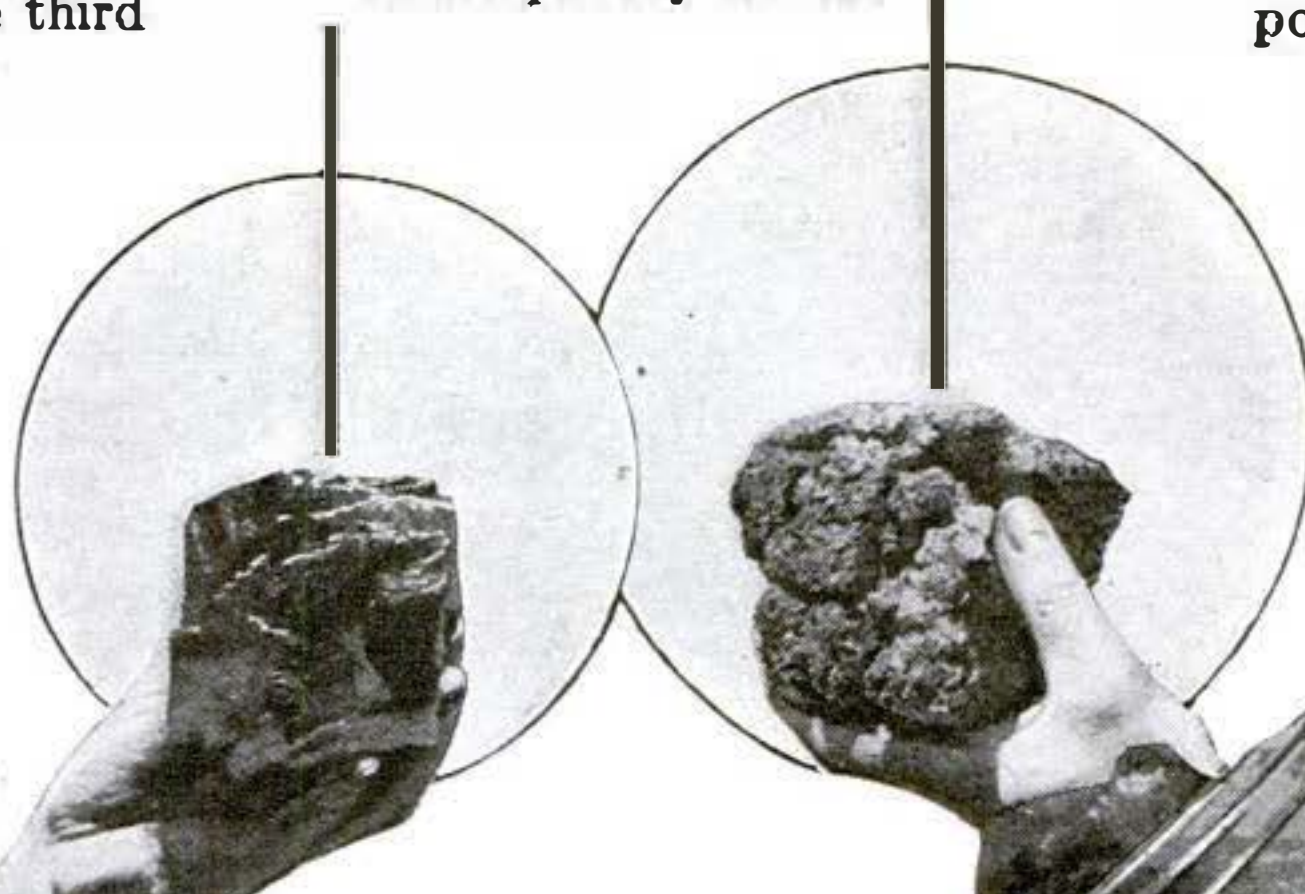
Use nut size for ranges, egg or stove size for furnaces or heaters, pea coke for self-feeders.

Coke, being lighter in bulk and of porous body, thus admitting air readily, must be fired in larger mass than hard coal, and it has been found best to use as small a size as will readily stay on the grates, stove, nut, and pea being the favorite sizes.

Remember that coke takes more space than its fuel equivalent in coal and arrange your bins accordingly.



Coke produces only one third of the amount of ash produced by an equivalent quantity of coal

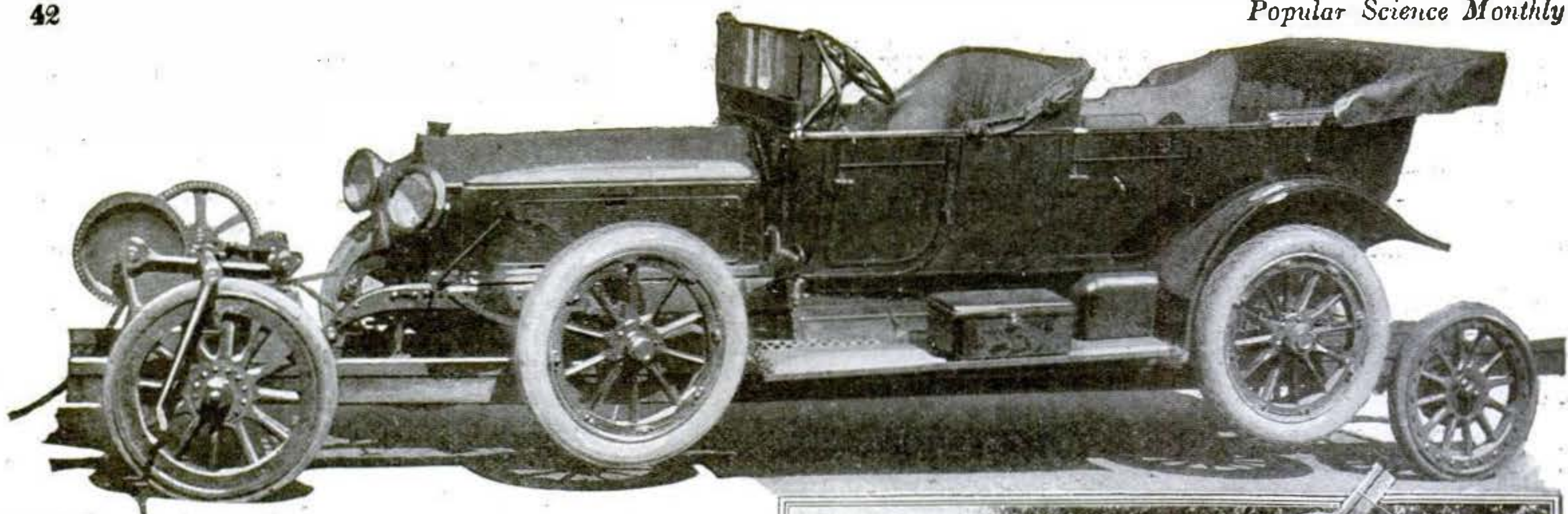


These lumps—coal on the left and coke on the right—are of approximately the same size, but the lump of coke will give you 30 per cent. more heat than the more solid-looking piece of coal—and no clinkers



Although coke has all the advantage in heat-giving qualities, and will "come up" more quickly in the morning than will a hard-coal fire, it is twice as bulky, the coal scuttle on the right holding the equivalent in coke of the coal contained in the more modest scuttle at the left. So build your bins large when you buy coke





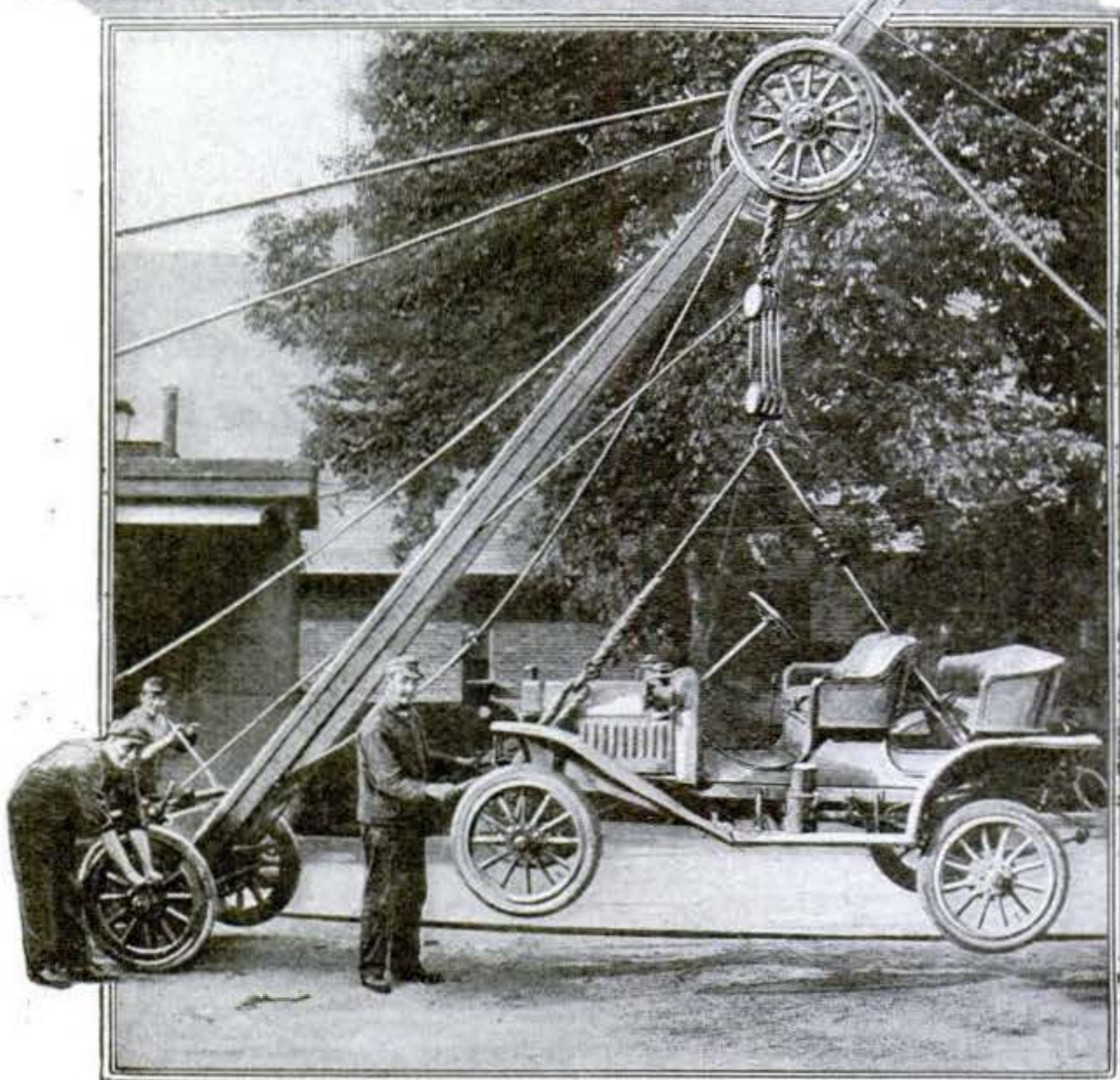
Every garage has a little wagon-like device upon which the damaged end of a car can be supported for the tow home. But the towing speed is low. Here's a new way of getting the car back to its garage at the rate of fifteen miles an hour. A four-wheeled truck is slipped under the car

When Your Car Breaks Down Call for the Automobile Ambulance

MOST of the devices so far in use for towing damaged cars home have assumed the form of small wagon-like conveyances to support one end of the damaged vehicle, leaving the other to run on the undamaged wheels. If all of its wheels were broken, it was necessary to load the entire car on a large-bodied motor-truck. Even with the small, wagon-like apparatus, the towing speed was low.

Now comes a New York manufacturer with a real four-wheeled ambulance trailer to carry the largest passenger car or motor-truck. The apparatus consists of two armored rails, a front and rear axle, and four rubber-tired truck wheels.

The front end of the frame is fitted with a rope windlass, which is used to pull the damaged vehicle upon the trailer frame. It also serves the dual purpose of crane shear legs; for it may be pivoted about the ground by means of guy-ropes and the windlass used to pick a car up from the bottom of an embankment.



If the car has come to grief in a ditch, the ambulance can be used as a crane to lift it back upon the road

A FEW weeks ago, New York saw its first gas automobile—that is, a car driven not by gasoline but by ordinary illuminating gas.

New York didn't know it. The car did not look any different from any one of the other 94,000-odd gasoline automobiles registered in the city, except for a small cylinder, forty-five inches long and eight inches round, mounted on the left running-board.

This was connected by a pipe with the carbureter on the gasoline engine, and filled with ordinary illuminating gas at a pressure of one hundred pounds to the square inch.

The car weighed 4,800 pounds, and in the tests carried out it was found that two hundred and seventy-three cubic feet of gas at atmospheric pressure (15 pounds) were equivalent to one gallon of gasoline, or enough to

Here's a Man Driving His Automobile through New York on Illuminating Gas

It looks like any other automobile. But it is driven by street gas, contained in the cylinder on the running-board



run the car six or seven miles.

Must we come to this for lack of gasoline? It is not likely. Gasoline is still plentiful and cheap.

Still, you never can tell. England is using street gas to drive cars. It's easy to understand why, with gasoline worth from one to two dollars a gallon. England has four thousand gas-operated commercial vehicles alone, to say nothing of several hundred passenger cars.

Gasoline is thus saved at the rate of approximately three million gallons a year. In France as well as in Italy the Government controls the entire gasoline supply, and theoretically not a single drop of this fuel is available for pleasure purposes. It is reserved almost exclusively for the use of the army and navy and a few important industries.

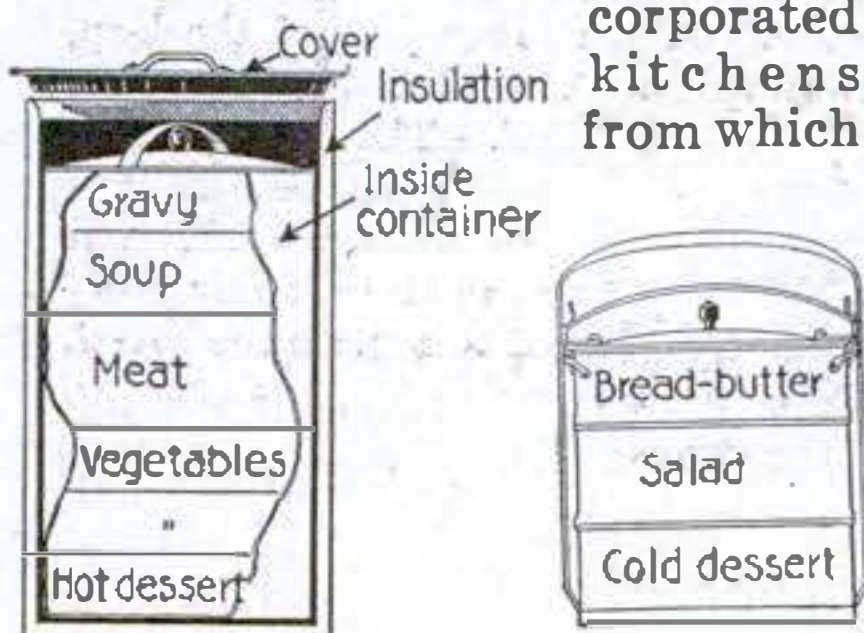
A Corporation that Cooks for You

TAKE your telephone from your desk, speak into it a few words, and presto! there will come to your door a piping hot dinner sealed up in a fireless oven!

This is the kind of wizardry performed by an organization of men and women who are trying to solve the vexed food problem of New York city. The housewife is going in for surgical dressings these days, and Bridget can get more in the munitions factories than for cooking. Food is high, coal and gas are costly. The sponsors of the new enterprise say that they can deliver these ready-to-serve meals at the door for about the price of the raw materials purchased by the housewife.

Inventing a Good Container

The service is a development of similar activities carried on with more or less success in other parts of world. Paris and Berlin have had establishments from which meals were sent all duly carved and portioned; and London had its incorporated



Everything from soup to nuts comes to your door in these containers

You subscribe for dinners as for a magazine and they are delivered ready to be eaten

By John Walker Harrington



The container does look like a milk-can, we admit. It's a fireless cooker in which a whole dinner reposes



What's she doing? Packing up a piping hot dinner,—yes, soup, gravy, and ice-cream are included,—which will be delivered to you for fifty cents

ponderous English dinners were sent before the war imposed simpler standards of living.

The efficiency of the New York system is due largely to the type of container that has been adopted. A year was spent in experimenting with various patterns of receptacles in which hot meals could be transported, and the one finally adopted has withstood every test.

A Six-Story Dinner

Since there are various prices and services, the capacity of the containers varies. Here is a sample menu that would be served to a minimum number of two persons:

Soup
Roast Chicken or Boiled Ham
Mashed Potatoes
Fresh Asparagus or Boiled Onions
Dressed Lettuce
Strawberry Shortcake or Molasses Cake

Each article of the menu is placed in a dish or bowl of aluminum, called an "inset." The bowls are well rounded at the base and have a flange on the outer surface, near the bottom, which permits of their being tightly fitted into a groove on the top of the bowl on which it is placed.

The bowls are placed in a rack, and this in turn is lowered into the container. On the top of the rack is a clamping device, by which the bowls can be so pressed together, the bottom of one becoming the cover of another, that they are hermetically sealed.

For those portions of the dinner to be served cold, there is a separate container, without a jacket, and consisting of two or three bowls of metal. The first one has bread and butter; the second, salad, with the dressing in a small paper cup; and the third a cold dessert.

In Case of Emergency

This service is especially available for emergencies. The meals have to be ordered early in the day, in order to insure their delivery for evening.

The average price for regular subscribers is fifty cents a meal for each person, the minimum service being for two people. When we consider the present high cost of everything, this price appears very reasonable. Such a boon to the public ought to warrant its spread to other cities.

The receptacle for the hot foods looks like an enlarged dinner-pail. That for the cold food is, of course, simpler. The aluminum bowls containing the food are nested so closely that no drop of liquid or any vapor can pass from one to another

By Taking Thought These

Farmers Now Have Mirrors on Their Motor-Plows

BECAUSE he must sit in front of his plowshares on a motor-plow, the farmer finds it difficult to perform at the same time the two functions of steering the machine properly and of observing the furrow behind. If he wants to ascertain whether the furrows are parallel, whether the plowshares enter the soil to the desired depth, and whether the soil is turned in the proper manner, he must turn around and look backward, thereby often bringing the plow out of its proper course.

In order to overcome this drawback, two French plow manufacturers have devised an arrangement of mirrors mounted on the plow in such a way that the operator can keep an eye on the tract of land ahead of him and still see that over which he has just passed.

One mirror is mounted in a practically vertical position in front of the operator and at a level slightly higher than his eyes. A second mirror is mounted on a support arranged in the rear of the operator's seat and extending rearwardly at an angle of about forty-five degrees.

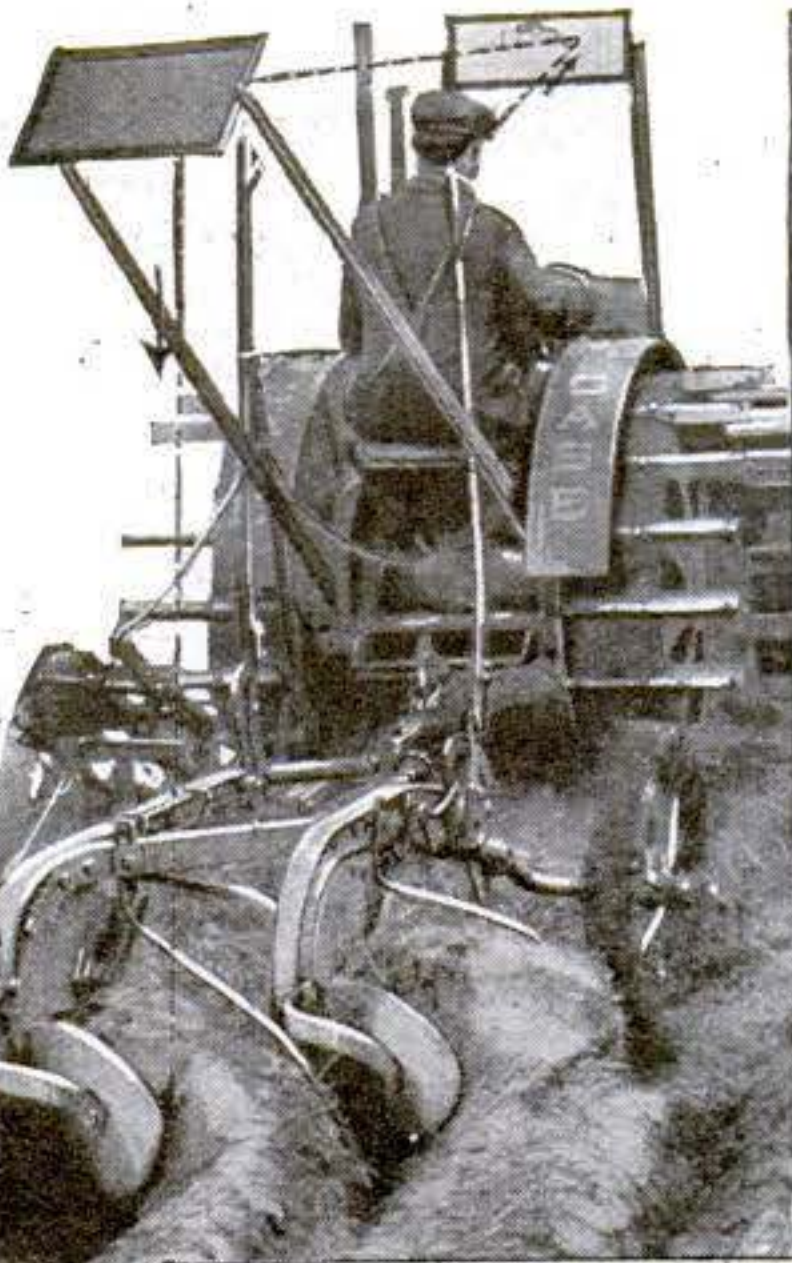
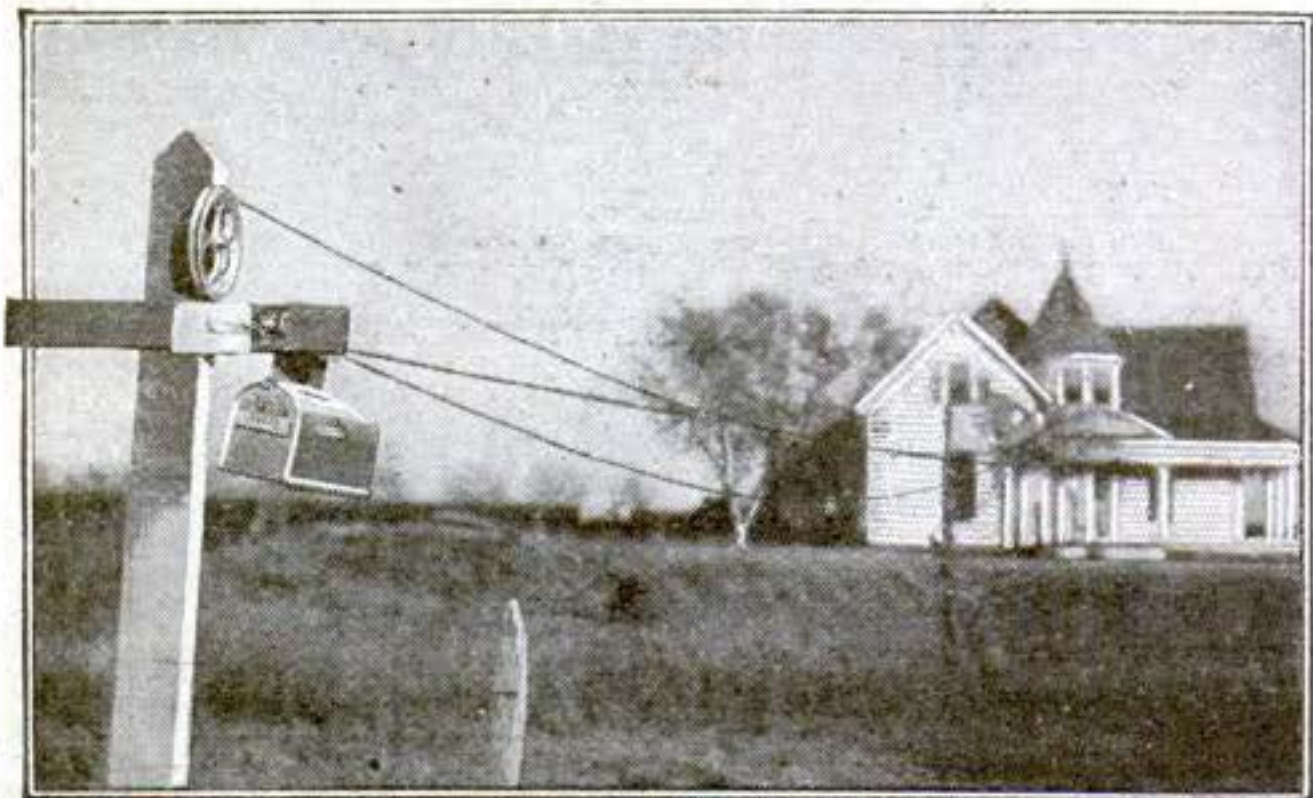
This mirror is inclined in such a manner as to receive a picture of a portion of the soil immediately in the rear of the plowshares and to reflect the picture on the vertical mirror, where it is seen by the operator. Hence it becomes possible to steer properly and to observe and regulate the operation of the plow at the same time.

A Traveling Mail-Box

THE breeches-buoy can be adapted to saving steps as well as saving lives, as a Texas farmer has proved. It is a long walk from his door to the roadside mail-box, where the rural delivery puts the Texan in touch with the outside world, and, as everybody knows, farmer are not fond of walking outside of business hours.

"Either I have to go to the mail-box, or it will have to come to me," said the farmer, and then he thought of the breeches-buoy.

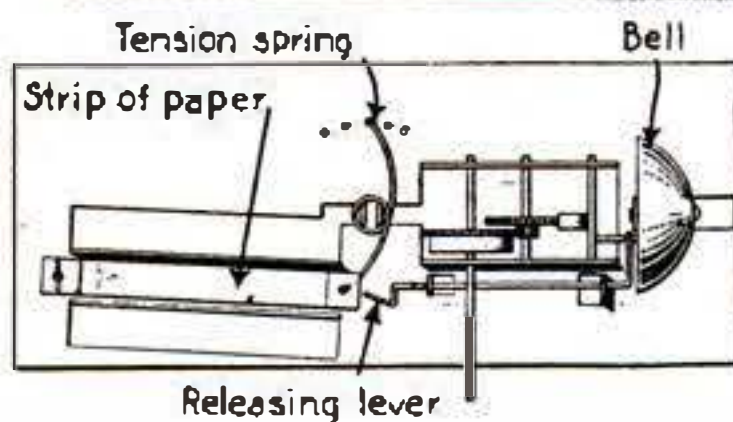
He took the mail-box from its post, and suspended it from a wire extending from the house to the post and running over pulleys after the fashion of an endless chain. Then he wired in an electric bell circuit with a push-button at the post, and all he has to do now is to go out on the porch and pull in the mail-box when the signal announces the arrival of the mail.



To Roll Barrels Uphill

TO get behind a barrel to push it up an incline is hardly less dangerous than to get behind a mule for a similar purpose. After several employees had been injured by barrels that slipped and rolled back on them, the warehousemen in a San Francisco plant hit upon an easy way to do the job.

They got two strong ropes, laid them down the incline in a loop, put the barrel in the bight, and then, standing on the lower part of the loop, hauled away at the free end, and up came the barrel. The double loop kept it from slipping. If it got away no one was hurt, and it took only a moment to replace the barrel.



A Bell Announces Rain

TING-A-LING! Ting-a-ling!

"It's beginning to rain; I'd better put the plants out to take a drink and close the windows," says the housewife. She hadn't noticed the first scattering drops, but outside the window they had dampened a slip of paper—the sentinel of her rain-alarm—which had broken, releasing a tension spring. The spring, in turn, had tripped a trigger, releasing a device exactly like that which operates the family alarm-clock, and the bell began to ring.

If you have an old alarm-clock and ingenuity you can make a rain-alarm for yourself.

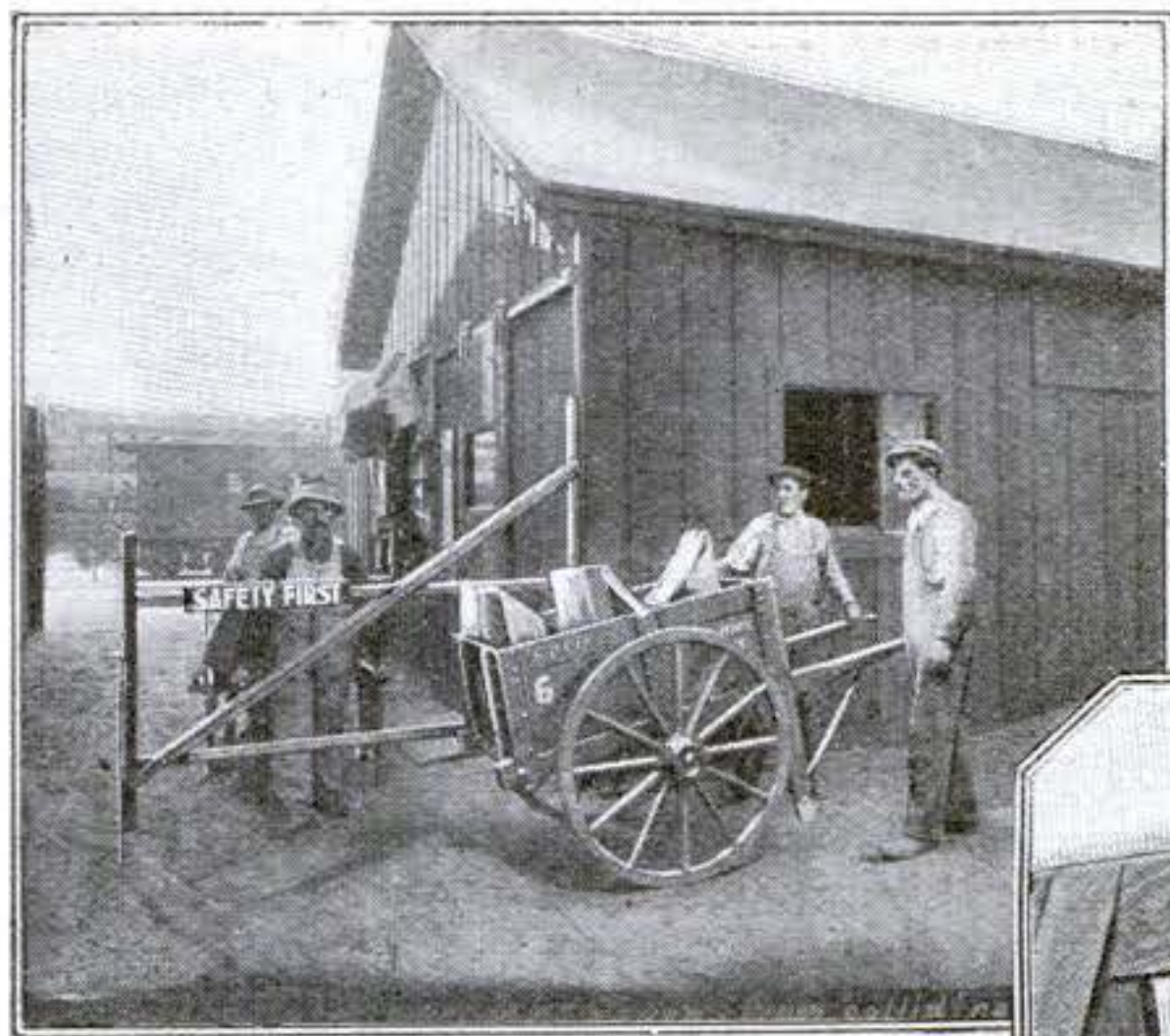


For the Writer or Flat-Dweller

IT is quite natural that George Vordermark, living in Indianapolis, the center of the fiction belt, should have turned his inventive genius to devising a combined chair, writing-table, and telephone-desk.

The picture tells the story. To quote the Patent Office, it is "so constructed as to be reversible as to position in a room or compartment, in order that it may be placed to the best advantage, . . . and may be placed to accommodate a left-handed subscriber." What more could be asked of a piece of furniture?

People Save Time and Labor



A Safety First Gate

IF we were able to see around a corner, half of the bumps and bruises of life would be eliminated. Nearly all traffic accidents occur at corners, for the very good reason that Bill Jones going north isn't able to see that Tom Smith is approaching from the west and that their lines of travel are going to meet unexpectedly.

In big cities traffic policemen take care of such troubles, but in railroad yards and manufacturing plants it is not practicable to guard every corner and alley crossing.

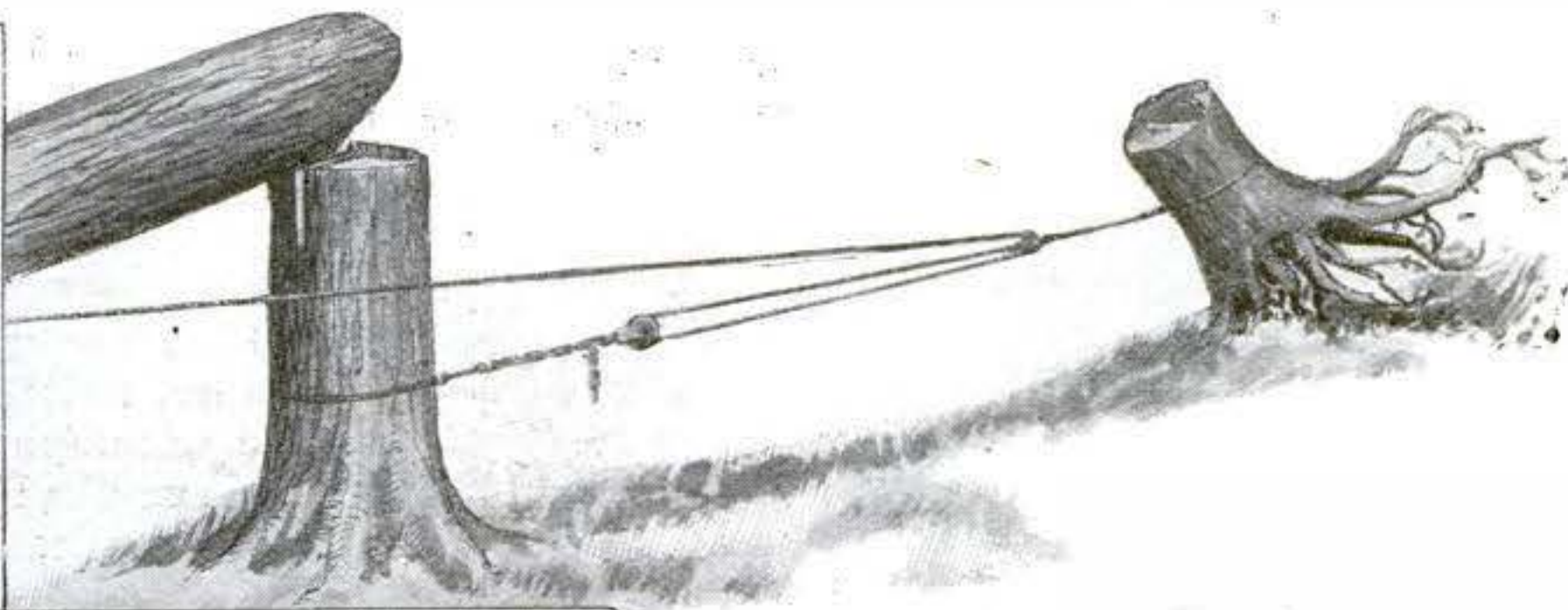
However, a "safety first" gate has been devised that can't go wrong or mix up its signals. And it's so simple. The gate is hung at the dangerous corner, so that in order to pass you must swing it so that it bars the way and gives its warning to anyone who may be coming around the corner.



No Hardship Now in Monday's Wash

AN electric washing-machine that can handle ten bed-sheets at a time is one of the newest labor-savers. As the picture shows, it does not even remotely resemble the old wash-tub that enslaved former generations of houseworkers.

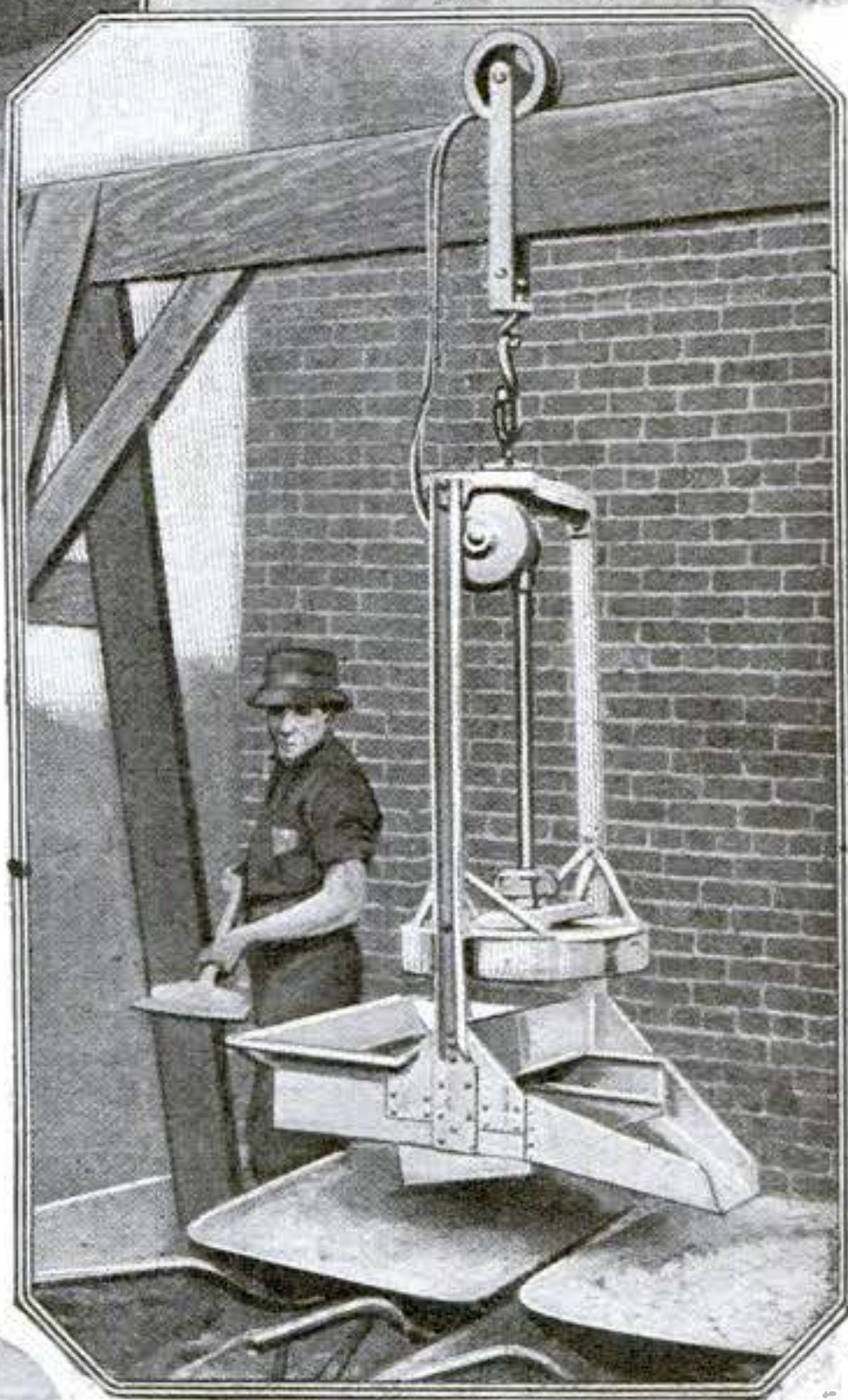
There isn't any rubbing to be done in this modern tub, which has no corrugations or rubbing devices, the principle being to utilize the surface tension of the water. The hammer stroke due to the elliptical shape of the tub breaks up the soapy water and drives it through the clothes.



Making Falling Trees Pull Up Near-by Stumps

WHEN a forest is cut down, many a horsepower of energy literally falls to the ground unheeded. Why not make use of the power of falling trees? Why not make a falling tree pull up a near-by stump? A man out in Newport, Washington, asked himself these questions, and then proceeded to answer them in a practical way by attaching the trunk of a tree about to be cut down to a stump.

When the tree falls, the pull on the cable gains power through the pulleys and is transmitted to the stump, which is uprooted. To prevent the butt of the tree from slipping, a spiked pivot-block may be inserted in the notch made by the axe.



Automatic Sand Screen

A MANUFACTURER of Leavenworth, Kansas, has introduced a new type of machine for screening sand. The machine is portable, and can be suspended from anything that will carry the weight.

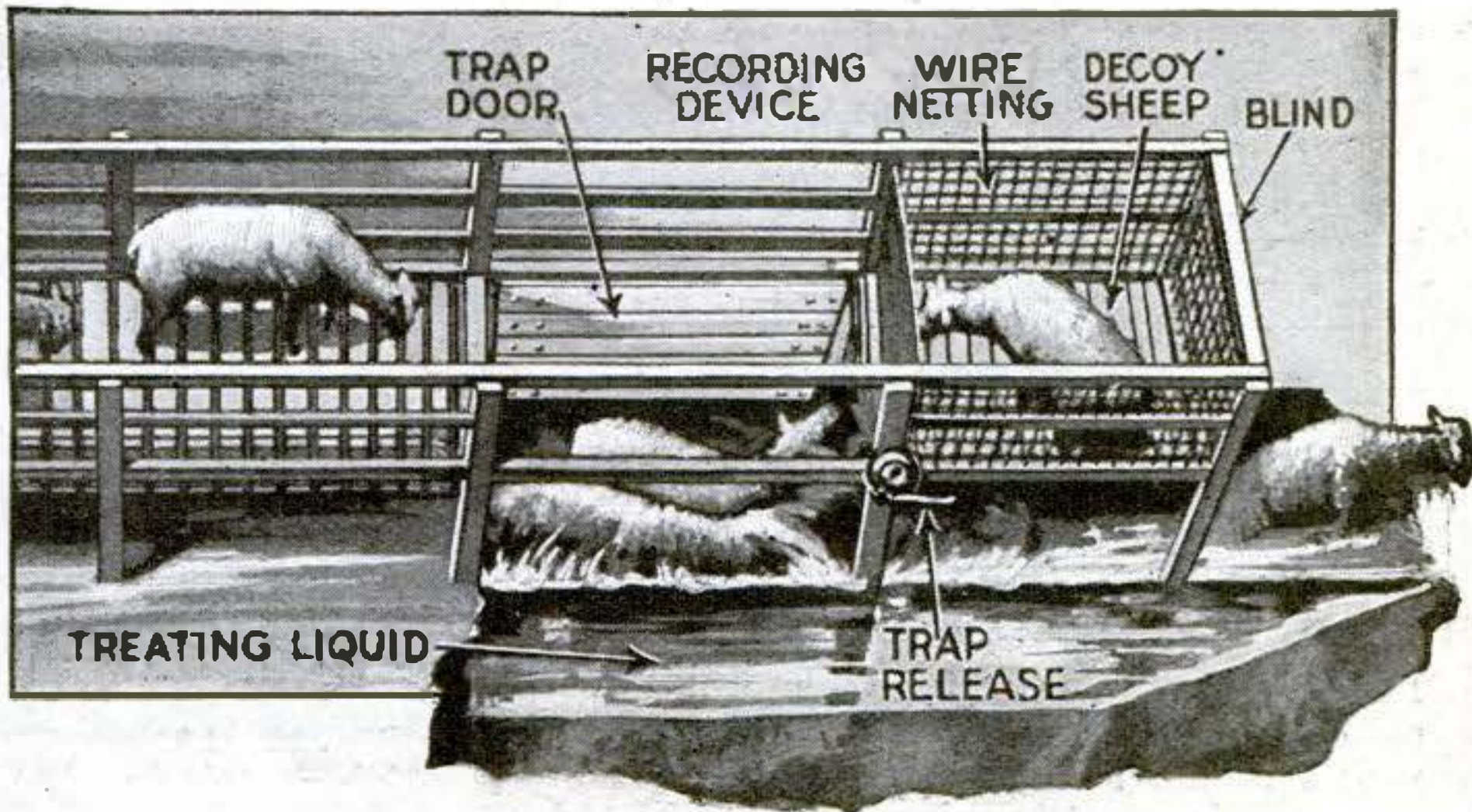
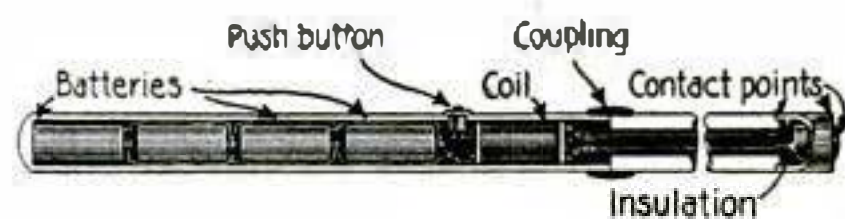
The machine makes two separations. The screened sand passes down through the sieve, and the gravel or refuse goes to one side through an inclined chute. Power is supplied by a small motor.

An Electric Cattle Prod

IF rebellious cattle refuse to enter the dipping-vat or the branding-pen, a little prodding with high-tension electricity has been found to break their stubbornness.

Ranchmen carry wooden rods containing a small shocking coil and four dry cells in the handle. The push button for connecting the batteries to the coil is also in the handle. The "business end" of the rod is threaded to the handle. This part of the instrument is of wood, and is solid except for a single hole through which a wire runs to connect one terminal of the coil with the metal tip of the rod.

When the push button is pressed, the batteries discharge into the shocking coil. It is changed into a current which reverses its direction many times a second. It reaches the metal tip of the rod and waits for some unsuspecting quadruped.



A Short Cut to Railroading

IF a child were to wander into the train-room of the Pennsylvania Railroad's Telegraph School in Philadelphia, he would find his dream of a toy railroad realized. Running around this room at about the height of an ordinary desk is a large U-shaped platform on which is a complete miniature railroad.

Here are wonderful little trains running on tracks with sidings, switches, cross-overs, and signals. Both telephone and telegraph block offices are located at intervals along this business-like little road, while at each end of it are terminals and complicated switches.

The purpose of this electrically operated railroad is to teach train-despatching, by both telephone and telegraph. Each student sits in what would be a regular tower if this were a real railroad. Those studying despatching by telephone have receivers over their ears, and the students of despatching by telegraph listen painstakingly to the dots and dashes of the Morse code.

In order to give the students an opportunity to practise switching trains from track to track, several trains are run over the line in different directions. The students in their towers learn to clear the block so as to assure safety to the various trains.

The school's entrance requirements are very simple. The men or women must be between seventeen and twenty-five years of age; their eyesight and hearing must be unimpaired; and they must possess a fair knowledge of English and know something of geography and mathematics. The tuition fee is two dollars a month, and there is an entrance fee of one dollar. To graduate, students must attain 95 per cent. in their final examinations.

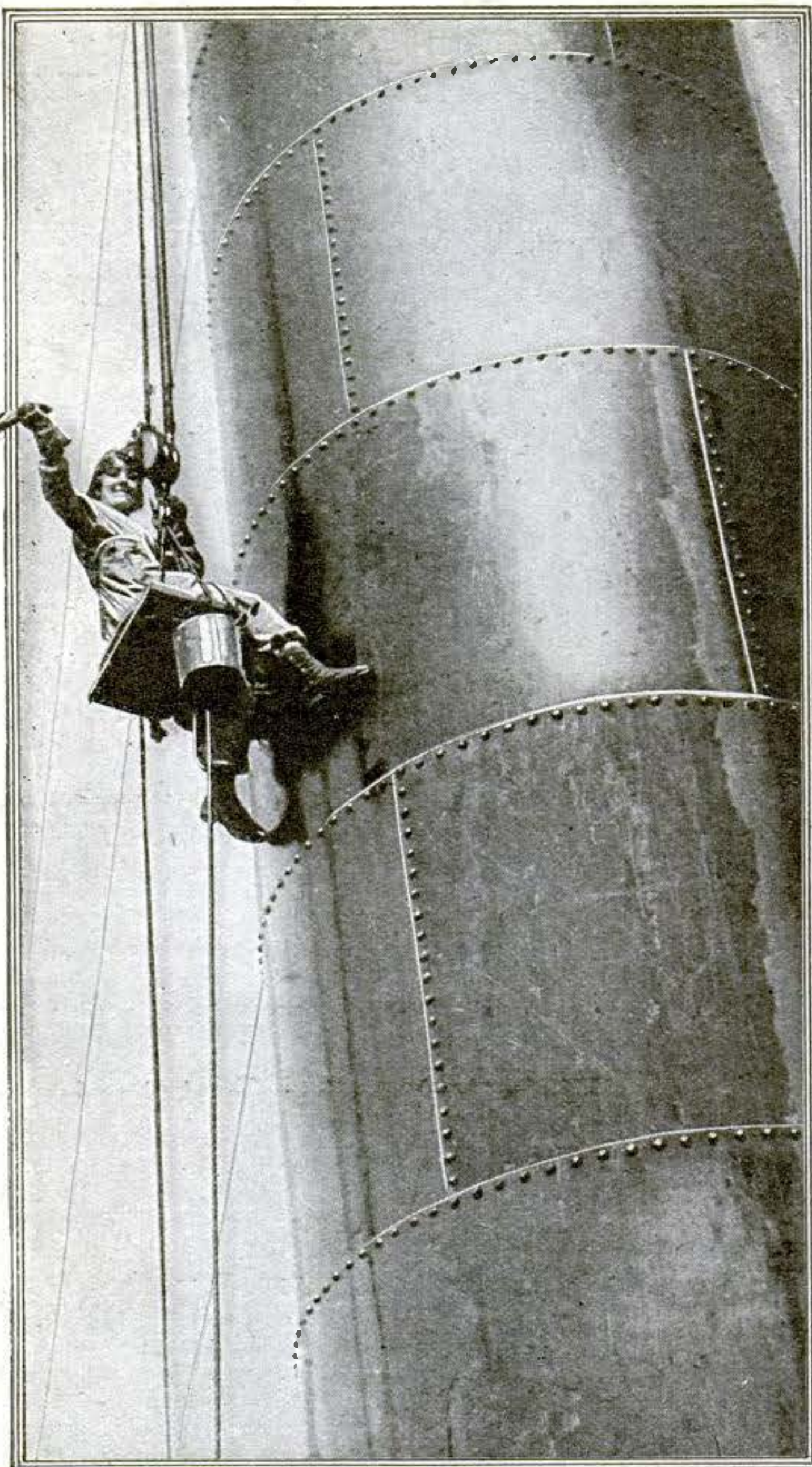
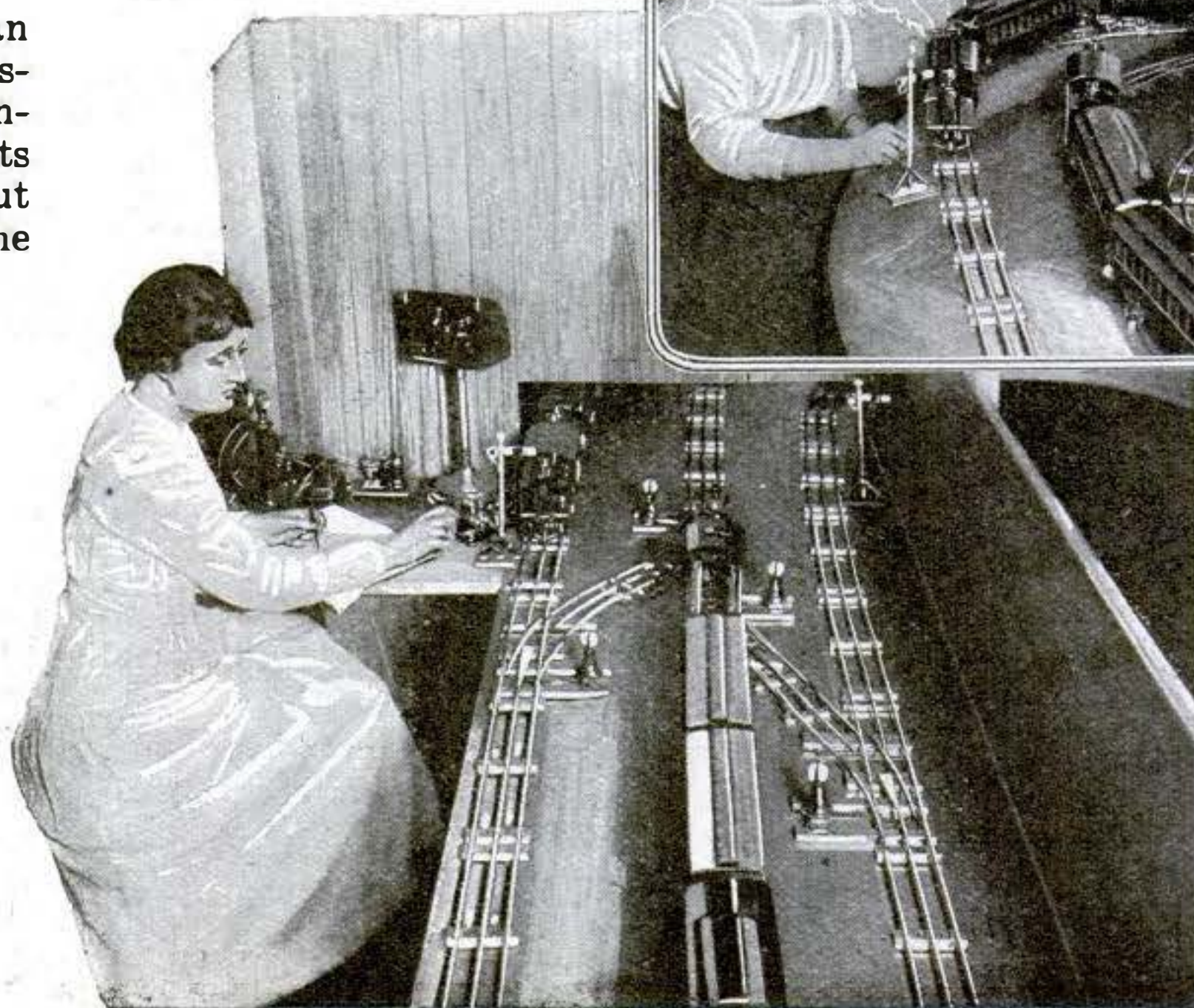
The six to eight months' course is under the supervision of Mr. J. C. Johnson, Superintendent of Telegraph. Mr. Thomas Saddington is chief instructor.

Graduates of the school may, if they wish, work for the railroad. After six months' employment they receive back the entrance and tuition fees they paid at the beginning of the course.

Learning all about railroad signals. These girls are fitting themselves to take the places of boys who have gone "over there"



This young lady will soon be doing railroad work. She is learning how to despatch trains by telegraph, with the aid of a miniature railway operated just like the ones you travel on. Advancement in this work is limited only by personal ability.



© International Film

Mrs. Thomas Wasselle makes California smokestacks beautiful while her steeplejack husband prepares to be a soldier

She Brightens Up the Sky-Line

JUST how bewitching overalls can really be made to become is illustrated in San Francisco every morning by a youthful brunette who gets into a pair of them and strikes out fearlessly for the upper strata of the atmosphere, with a paint-brush in one hand and a can of paint in the other.

She is a steeplejackette, and her job is to keep the spires and stacks of San Francisco beautiful while her husband goes and helps Pershing. Dangling from a tiny wooden sling hundreds of feet up in the air, she cheerfully slaps on the paint.

Because women have a finer sense of color than men, it is reasonable to presume that San Francisco's sky-line will soon be so delightful to gaze on that people in the streets will be in danger of frequent collisions.

Building Concrete Ships in a Hole

WHEN a ship is about to be launched, everybody is gay except the shipwright. It's fine to see the flags flying, to hear the band playing, and to gaze at the pretty girl who has been selected to break a bottle of champagne over the stem.

When the ship slips down the ways everybody cheers — everybody, that is, except the builder.

What's he worrying about? For one thing, the ship may crush herself at the critical moment, when the weight of the bow is supported at but one point on the ways, while the stern is buoyed up by the water.

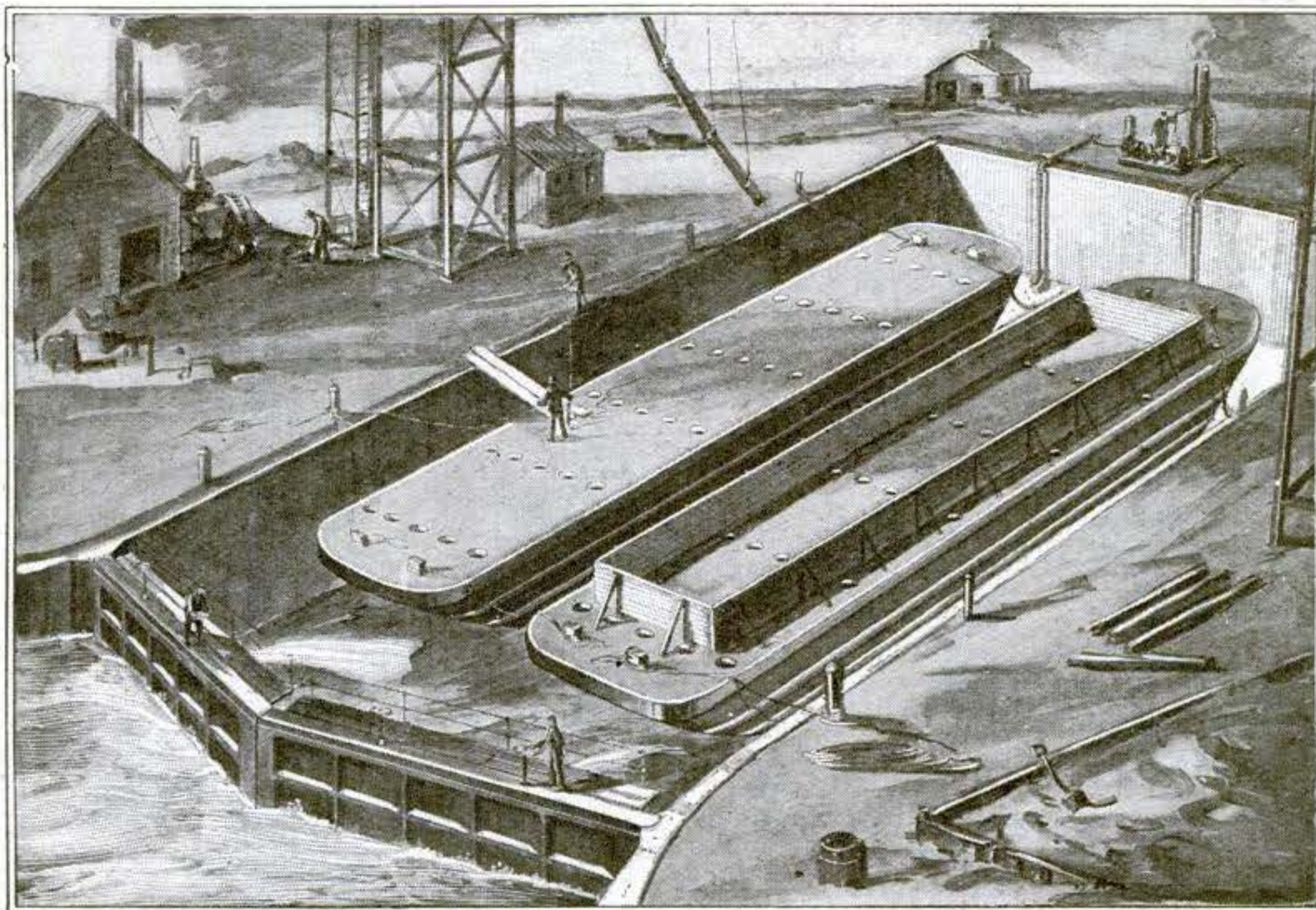
Not until the entire ship is in the water does the shipwright begin to cheer too.

It has occurred to Nils F. Ambursen that all this worry may be avoided by the simple expedient of building the ship in a hole in the ground and letting in the water when it is time to float her. He is proving his point by building some concrete barges in holes in the ground.

By a hole in the ground we mean a dry-dock; every dry-dock is nothing more, except that it is

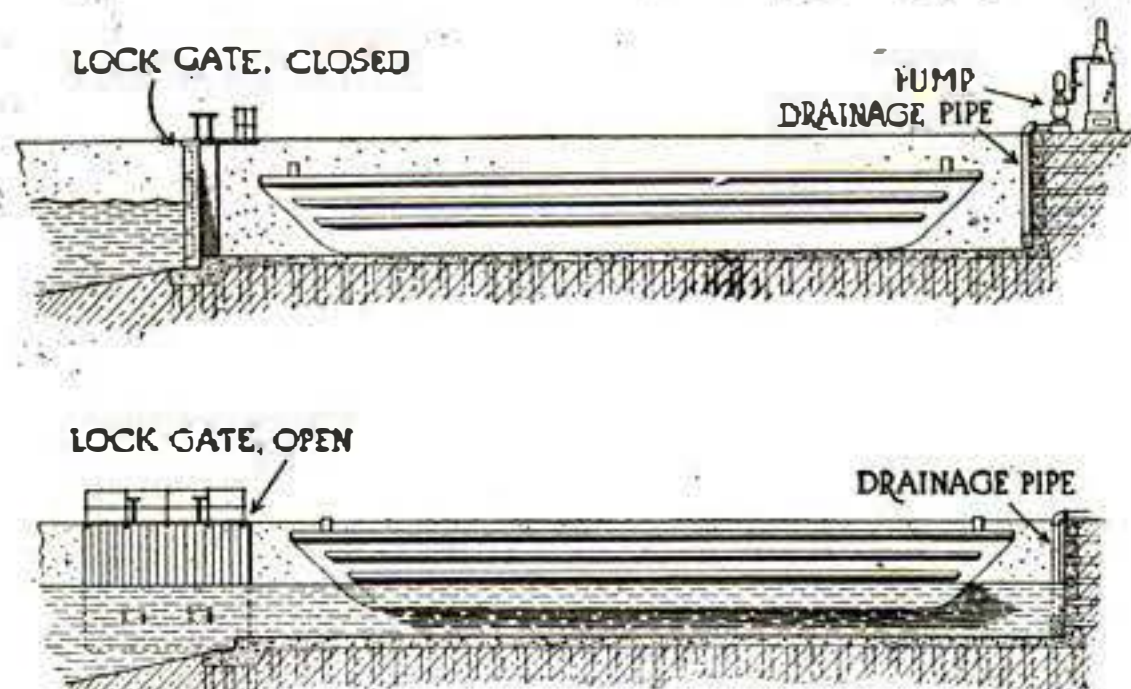
How Nils F. Ambursen is reducing the cost of barges and avoiding launching risks

By Joseph Brinker



Building Two Concrete Hulls in One Hole

All but the top decks are to be built with the cement-gun (described in "One-Piece Ships of Stone," published in the POPULAR SCIENCE MONTHLY for October, 1917). Movable steel forms constitute a backing to prevent the cement shot under compressed air from passing clear through the wire-cloth and reinforcing rods. Mr. Ambursen holds that by adopting these movable forms he can reduce the cost of building a concrete barge by at least twenty-five per cent

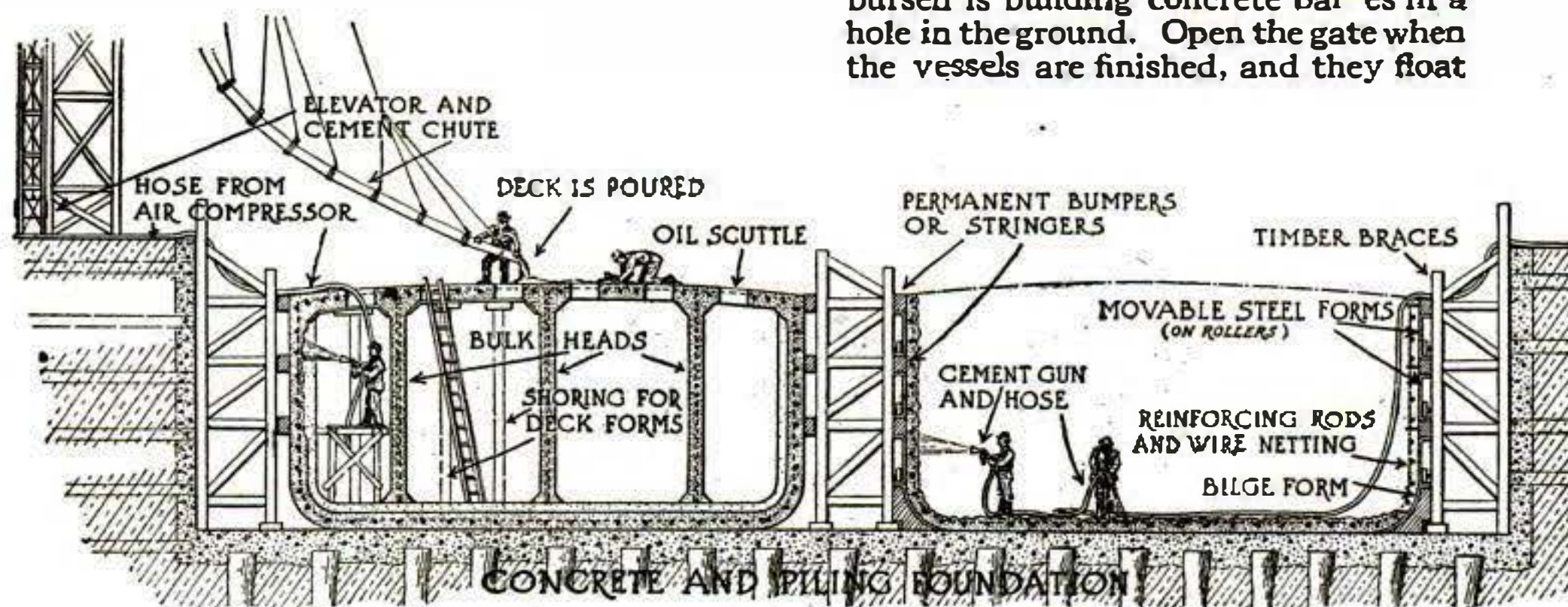


Because the launching of a ship is attempted with great risk, Nils F. Ambursen is building concrete barges in a hole in the ground. Open the gate when the vessels are finished, and they float

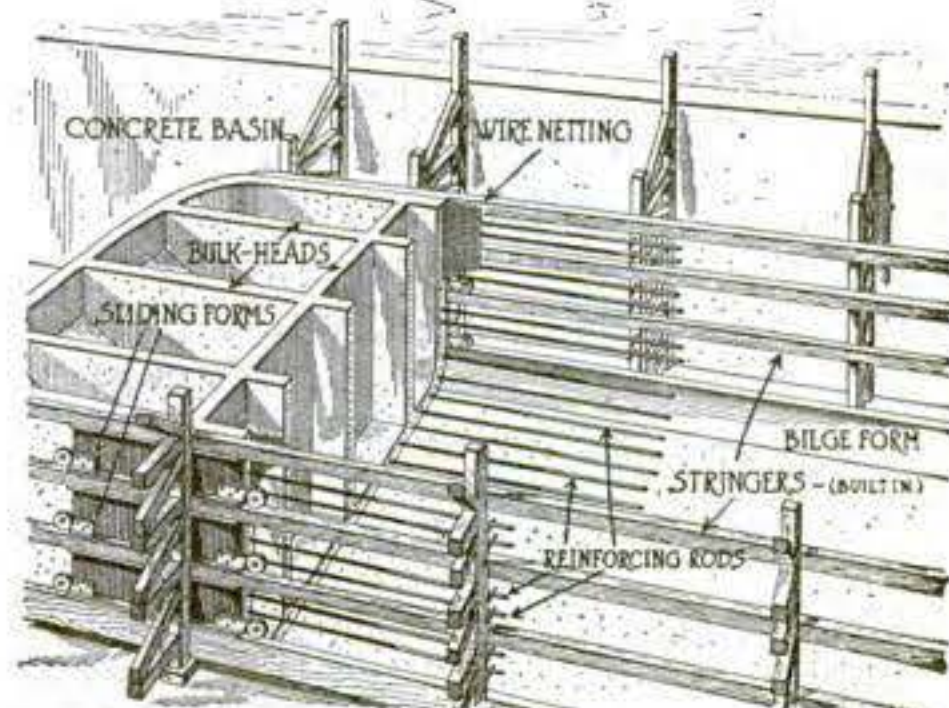
the initial cost of building the dry-dock.

It is merely necessary to build the dry-dock or pit so that its floor is below mean high-water mark. As soon as the gate is opened and the water rushes in, the vessel is lifted off the bottom automatically.

If the pit is wide enough, two vessels can be built at the same time and launched together, thus materially decreasing labor and expense.



The U-shaped metal forms are moved along the stringers on rollers as the work proceeds. One form will serve for "shooting" the concrete of an entire section



Wooden stringers serve as supports for the movable forms and the reinforcing

Safety for Young Speed Demons



Shooting an arrow into the air and scrambling for the tiny parachute that opens and floats down



PERHAPS because the young of our prehistoric forebears learned to like the sensation of being tossed from tree to tree, that love of the sinking sensation has outlived time.

Anyway, it is difficult to account more rationally for the glee with which the children of this fastest of all ages go their parents one better and take to such breath-expelling contrivances as the "shoot the chutes," when more precious and more intricate toys are to be played with for the reaching.

Why will children, from the ages of four to forty, climb tirelessly time after

time up a flight of steps, in order to slide down a chute with fiendish joy in their eyes?

Out in Anderson, Indiana, a manufacturer with foresight has fashioned a "shoot the chute" that removes all the hazard from chuting, with the possible exception of a few harmless bumps; for, no matter how prudently a chute is constructed, youth will occasionally manage to bump his anatomy somewhere.

The real danger in slides heretofore has been at the launching point. In the excitement of getting started, children have often fallen off and been injured. The Indiana manufacturer has sidestepped such catastrophes by providing his chutes with hand-rails at the tops. The children must crawl under the rail before they can launch themselves down the incline.

A New Game—Catch the Parachute

A TOY that smacks of the bison-hunting Red Man has been put on the market for children.

An arrow, with a little silk parachute on the pointed end of it, is shot into the air by a bow. When the arrow goes as far as it can, it falls back, and the parachute opens beautifully and floats to the ground, whereupon there is a mad scramble to reach it.

Bows and arrows in all forms, provided the arrow-points are dull, always make good playthings for children. They develop steadiness of nerve, precision of eyesight, and a certain amount of sturdy muscle.

Prize Cups to Help Lick the Prize Maniac

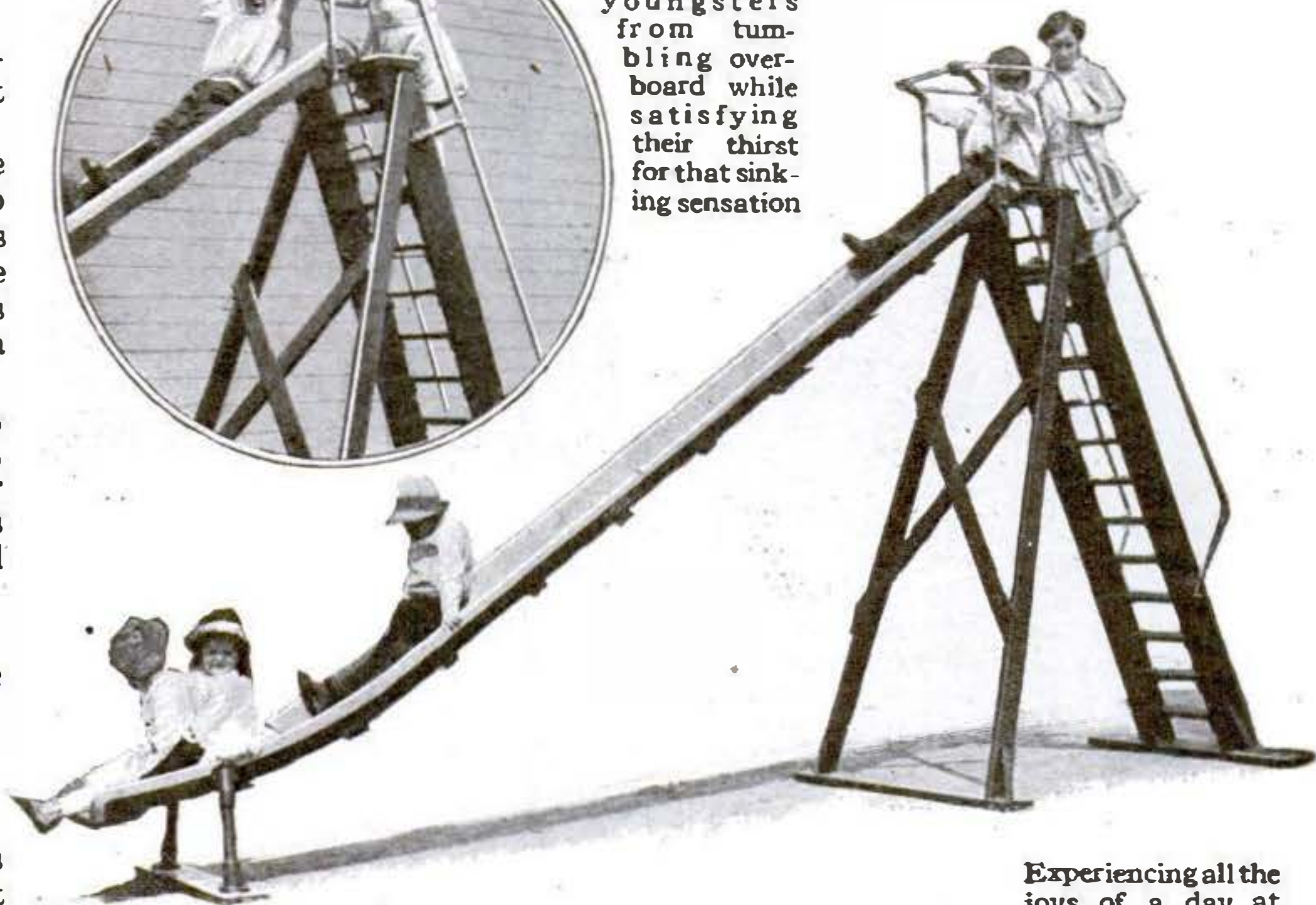
PATRIOTISM receives a pretty stiff test when a boy is asked to consign his precious silver trophies to a junk-pile. Yet that's what Brooklyn high-school athletic champions did a little while ago, willingly, to show that prizes could be given away with the same fine sportsmanship that won them.

The trophies were melted into ingots, and sold to the United States Mint, the returns being applied to the Red Cross Fund for Wounded Soldiers.

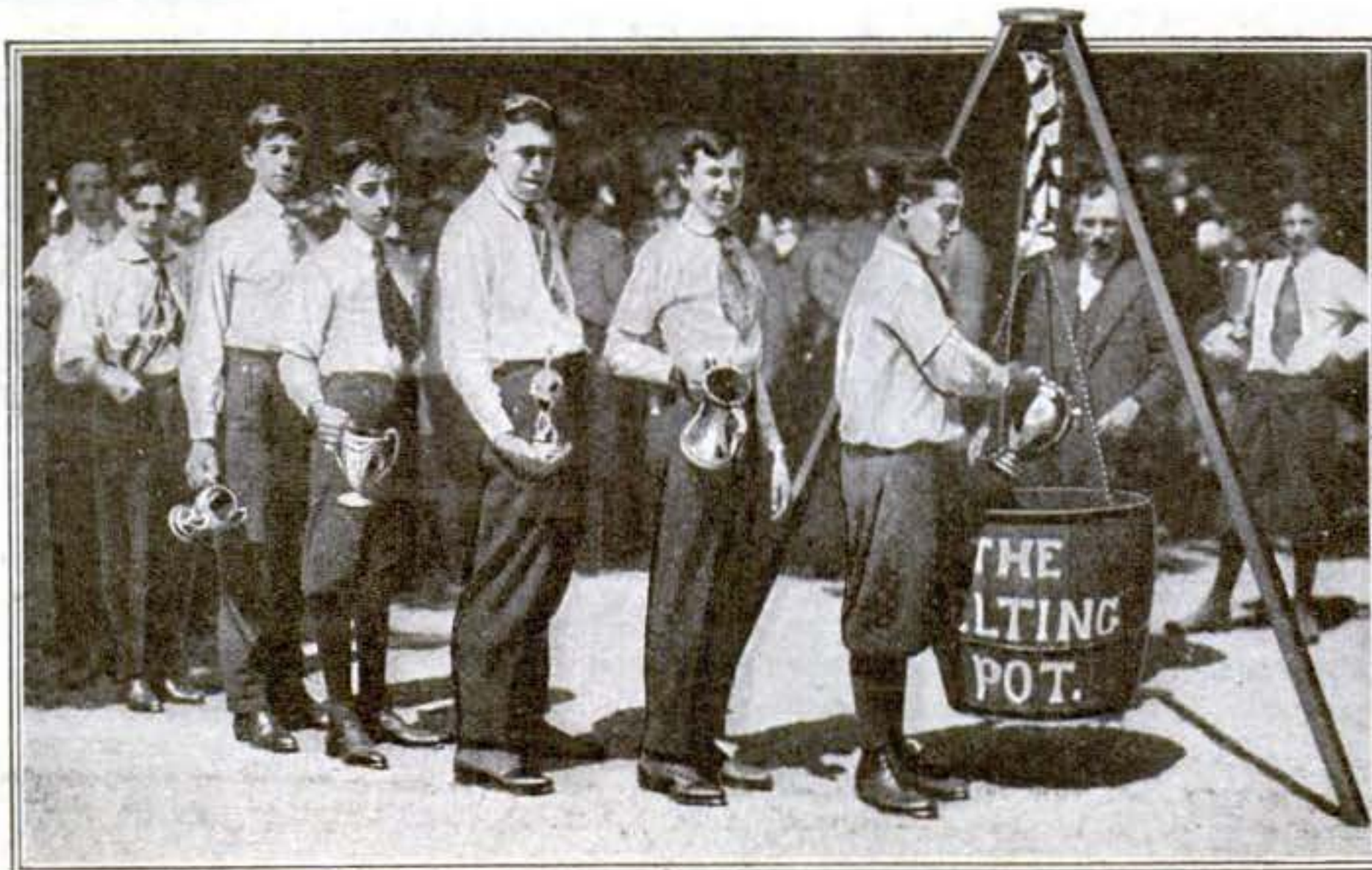
The "melting-pot" was a feature of the 33,000 Brooklyn high-school boys' demonstration in Prospect Park.



The hand-rail at the top prevents the youngsters from tumbling overboard while satisfying their thirst for that sinking sensation



Experiencing all the joys of a day at Coney Island in their own backyard



A scene in Prospect Park, Brooklyn, when the high-school boys of that borough of New York city assembled to give up their hard won athletic trophies to help the Red Cross Fund for Wounded Soldiers

Shot Down from the Clouds

By Lieutenant C. R. Wickenden, Royal Flying Corps

THE day before I was "put through the mill" had been a busy one. For that matter, so were several days that preceded it. Every hour was filled with excitement. I pick out the day before, however, because it was on the final patrol in the evening that I had a last opportunity of using my guns, and because it brings out the rapidity with which events succeed one another in an aviator's life.

As the Commanding Officer of the squadron of chaser scouts to which I belonged (a squadron, I may say, bearing as high a reputation as any on the Western front) came into my section of the huts in which we were billeted, I realized at once by the look on his face that he was going to give me something unpleasant to do. He had been promoted, step by step, from a flying officer to a flight commander, and finally to the command of this fine squadron, because of his hard, efficient work. He expected us younger pilots, in turn, to do our best.

Getting Ready

It was barely daybreak, yet there were the noises of early-morning ablutions coming from several of the surrounding cubicles, and from one curses muttered at a pair of missing goggles — eventually found, I believe, under the mutterer's pillow.

"Well, Wicky, old man, I want you to take up 28-0-4 on the second patrol this morning. I hate to send you up on a strange machine, but you know how short we are, and both the other boys are green, so there's not much else I can do. I'll order the machines out at seven-thirty, so you'll be ready, won't you?"

He knew perfectly well he was asking me to do something that, in a fighting pilot's belief, spells trouble—that is, to fly another man's machine. Like the fatality supposed to hang over the third to light a cigarette on a single match, this superstition is deeply rooted in the Flying Corps. Many premonitions of evil came to me during the minutes

—I say minutes with a meaning—between 5 and 7:30 A. M., at which time we were to leave the ground.

As he left the hut, I jumped out of

bed to look at the weather. As I did so, Bradley, in the next section, called over: "Rotten luck, Wicky. You'll be going up as we come down; see you later, Cheerio!"

He came down—but not on the right side of the lines, and not in the usual way. He was shot down in flames just twenty-five minutes before we left the aerodrome.

Off They Go After the Enemy

The sky was brightening now, and the first patrol machines were circling the aerodrome, getting their height before leaving for the lines. The clouds were quite high, but dense, and there seemed to be no break from one side to the other. It meant that we should have to fly along underneath them in order to find "the odd Hun," as we always remarked. This was an advantage to them, because our course lay several miles over their side of the lines: consequently they could fly among the lower clouds, vanishing periodically and waiting for a straggler from one of our patrols.

It is hard for a pilot near by to see an airplane flying through thin clouds, although the clouds may not hide the machine from observers on the ground.

Some of the most thrilling stories of the war will go untold because it so often happens that those who excel in the doing consider the most remarkable exploits "all in a day's work." And when an editor does manage to get the details of such a tale as that told here by Lieutenant C. R. Wickenden, of the Royal Flying Corps, and wants to tell his readers something about the man himself, he faces the stone wall of modesty that most brave men erect around themselves. When we asked him to tell the readers of POPULAR SCIENCE MONTHLY something about his life, Lieutenant Wickenden sent us this:

"I was in the States in '14, and realized that I was wanted over on the other side, so joined the Canadians in Toronto as a private. As I had been in an officers' training corps in England while at school until I was eighteen, I was rapidly promoted sergeant, and eventually when a call for flying corps pilots was issued I volunteered and was given a second lieutenancy.

"I proceeded overseas as a second lieutenant, and after the usual training proceeded to France. After several months of service I was shot down, as you know, and have now been invalided out on account of my wounds."

Promptly at seven-thirty the three of us were stretched in our seats, our engines "ticking over," awaiting the signal from the C.O. to go. He came over to my machine, jumped up on the side step, and gave me final instructions. Then, with a wave, he signaled



*Yours
very truly
C. R. Wickenden*

us to "take off." Immediately we opened up our engines. A few seconds later we were circling the aerodrome, following the first patrol.

Just as we got up to about 5,000 feet the remainder of the patrol flew over our heads. I noticed that there were only three machines instead of five.

We had received news the evening before that Richthofen and his "circus" were in the vicinity. It was assumed that our fellows had been in contact with them, which afterward proved to be true. We had downed three Huns, but we lost Bradley and another man, both down, one in flames on their side of the lines.

As we circled up, however, I am sure that we all tried to forget the three men above us—to look forward more to a little fun on our own account. The air was bitterly cold. Although I had clothed myself as warmly as was compatible with free movement of head and arms, the cold began to gnaw through. I had to move around frequently to avoid stiffness.

On leaving the ground in the early morning one generally notices every detail of clouds, ground mists, etc., as one circles for height and heads toward the lines. It had rained hard on the previous day, causing the

ground mist so prevalent in northern France (and such a hindrance to flying work) to be pretty general. This mist rolls along with the wind, completely obliterating ground objects while passing over them. This, of course, makes it very easy to lose one's



position. Above us there was the impenetrable layer of gray clouds under which we were going to patrol.

"Forewarned is forearmed," the saying goes. I wonder if it is applicable to the air. Sometimes I think not. Although we had been warned of Richthofen and his "black and whites" (their machines were painted in black and white squares at that time), and although at first we kept a very careful lookout, the continuous patrol without unusual events tended to make our spotting less accurate toward the end of our time over the lines. I have to admit that, at the time our trouble came, my mind was far, far from France, but it only needed a chance side glance to bring it right back.

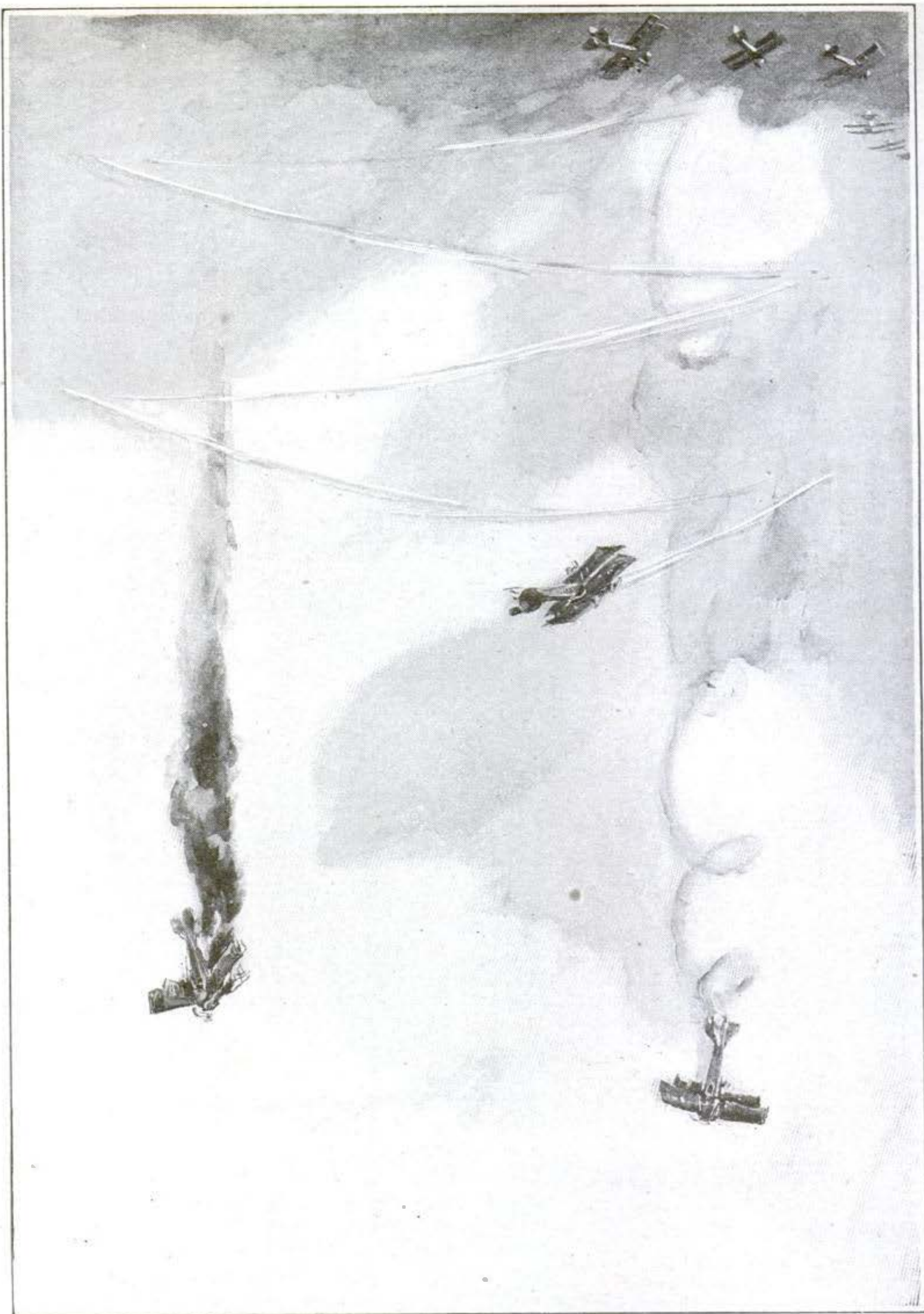
What a Pilot Thinks of When He's Flying

It may be hard to believe that on such work as this a pilot can allow his thoughts to wander to things not having any connection with fighting while flying several miles over the enemy's lines. It is nevertheless true; for if he allowed himself to live over what he has already been through, or to imagine what might happen to him some day, his life as a pilot would be materially shortened. The nervous strain is tremendous, and thoughts of this nature would increase it to the breaking point.

It is a remarkable fact that the great majority of thoughts passing through a pilot's mind when not actually fighting are of happy events, either past or shortly to come—the most prominent, perhaps, being that of the two weeks' leave that comes very frequently and regularly in the Flying Corps. The great idea is to keep the pilot's mind off what is happening.

Black Spots in the Distance

About ten minutes before we were due to leave the route of patrol, I spotted six small black dots in the far distance over the Hun lines, flying just between the clouds, at about 1,500 feet above us, according to my rough estimate at the time. As we were flying at 11,000 feet, this gives the height of the clouds at about 12,500 feet. The six black dots were flying due south, and we east-northeast. I had set this course, as was our custom, to make sure that there were no Germans near our lines, ready to dash over and take photographs or drop bombs in the short period that sometimes elapses between departure and arrival of patrols.



"Just as I lost control," says Lieutenant Wickenden, "the boy on my left went down in a spin, with flames spouting out of the tail of his machine." The controls of the Lieutenant's own machine were shot away. The engine was dead, and the machine started on its last sickening journey to earth. It dropped as shown by the zigzag lines in this illustration, slipping down first on one wing-tip and then on the other. Thus the dive was momentarily arrested from time to time. It hit the ground four hundred yards out in No Man's Land

The six dots in the distance disappeared as their leader directed them into the thin lower layer of clouds. It was this that gave me the information necessary to indicate enemy machines. Several times after this, one or more of these black specks would disclose itself by coming down out of the clouds. This gave me an idea of the course they were taking. The dots developed into biplanes of the scout type, and at a distance looked very similar to a famous French and a famous British scout. In fact, the similarity

is so pronounced that on more than one occasion a French and British machine have engaged in a fight until either one or the other has displayed his national markings.

All my calculations were upset as the airplanes came nearer, for they seemed to change their course to due east—that is, back toward their aerodrome. Naturally, I supposed that they were leaving us. As time went on I could pick out now and again in the far distance an odd machine below the clouds in the east. I had

almost returned to that state of content which prevails on an easy patrol.

Richthofen's "Circus" Appears

I was on the point of turning westward on our way home, when, without the slightest warning of any kind, the *rat-tat-tat-tat* of what seemed to be numberless machine-guns resounded through the air. In the twinkling of an eye, seeming quiet was converted into absolute chaos. The sending down of the few machines that I had seen coming out of the clouds in the far east was a very clever tactical maneuver to conceal the whereabouts of the remainder. In the first few seconds of any surprise attack like this, I think that the attacked always loses his head. I certainly did.

Tracer bullets whizzed by in every conceivable direction. I saw the boy (he was only eighteen) on my right turn on his back and start on that awful journey to earth. He must have been killed in the air by the concentrated machine-gun fire. As I saw him fall, I attempted to pull my machine up on its back and get round at the two airplanes on my tail. Instead of going on its back, it floundered hopelessly forward and down just as their last effective burst struck me. The bullets smashed through the tail, pierced the gasoline tank, cut my controls, and struck the engine.

I felt a sharp twinge in my left knee at this second, and I knew that I had been hit. Just as I lost control, the boy on my left went down in a spin with flames spurting out of the tail of his machine.

This last burst had cut four wires, the two aileron controls and the elevator controls. The control stick simply came away in my hand. My

engine was dead. The machine was starting on its last sickening journey to earth. Death seemed certain.

This type of machine had to be very carefully nursed in landing so that even if she didn't rush straight down into the ground she was bound to hit it with sufficient force to smash me to pulp. It was merciful that I began to lose consciousness. The machine went down (as shown in the illustration on page 50) in a series of swoops. First it slipped down on the right wing-tip until it attained a speed of about 250 miles an hour. Then, suddenly, by the action of the terrific pressure of air, the loose ailerons, used to balance the machine from side to side, were forced from one extreme to the other.

Thus the dive was momentarily arrested and the machine brought to a dead stop in the air. Then she started to swoop down on the other wing-tip. The same erratic evolutions were performed, but reversed.

Braving Death to Save a Comrade in No Man's Land

I remained conscious from 11,000 feet, the height at which we were attacked, down to 5,000 feet. After that everything quickly became black. What happened after I lost consciousness was told to me by an officer who risked his life by crawling from the British front-line trench to the spot where my machine hit the ground, some four hundred yards out in No Man's Land. He managed to bind me up and get me back to the front-line dugouts without either of us being bit.

I learned from him that my machine continued its wild swoops right down to the ground. At the end of the last side plunge it dashed across No Man's

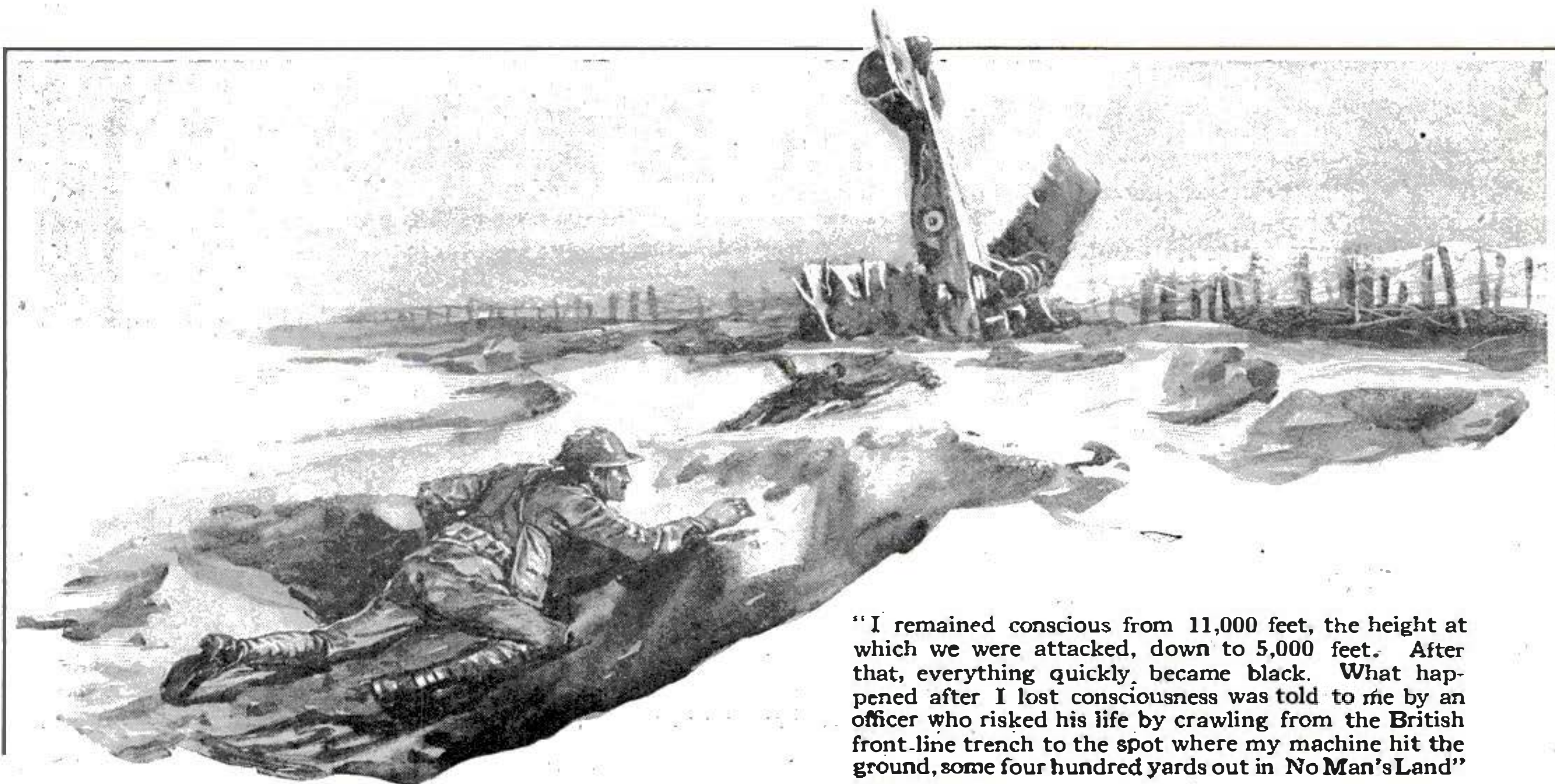
Land at a height of only twenty feet from the ground at a speed well exceeding 200 miles an hour (as he put it, "the wires whistling"); and after stopping dead, some 150 feet up, it dived into the ground, the right wing-tip striking the ground first.

By a miracle I am still alive. Perhaps I owe my life to the fact that when the machine began its downward course I unfastened my three belts, so that if the machine caught fire I should not be caught like a rat in a trap; perhaps to the fact that the machine didn't dive, nose first, into the ground, and that the force of the fall was partially broken by the wing's crumpling up, and perhaps to the fact that when the machine struck earth I was thrown into the soft mud of a shell-hole thirty feet from the wreck.

So far as I know, I am the only man who has passed through such an experience and lives to relate it.

I am sure it will interest readers of this article to know that Lieutenant Parkes, the man who brought me back from No Man's Land, has been awarded the Distinguished Service Order for his bravery, and that the last news I had from him was that he was still fighting the Hun, not in France, but in Italy, where he is doing the same sterling work and has earned additional decorations. I know that, with me, you will hope that he comes safely through to a richly deserved rest when the Hun is finally beaten.

Now that American-born boys are going through adventures similar to mine, I hope that they will have the same good luck that has brought me back to the home of my adoption. Though not as sound physically as I was before, I have the feeling that what little I could do to "strafe the Hun" has been done. And, believe me, it is a feeling of content.



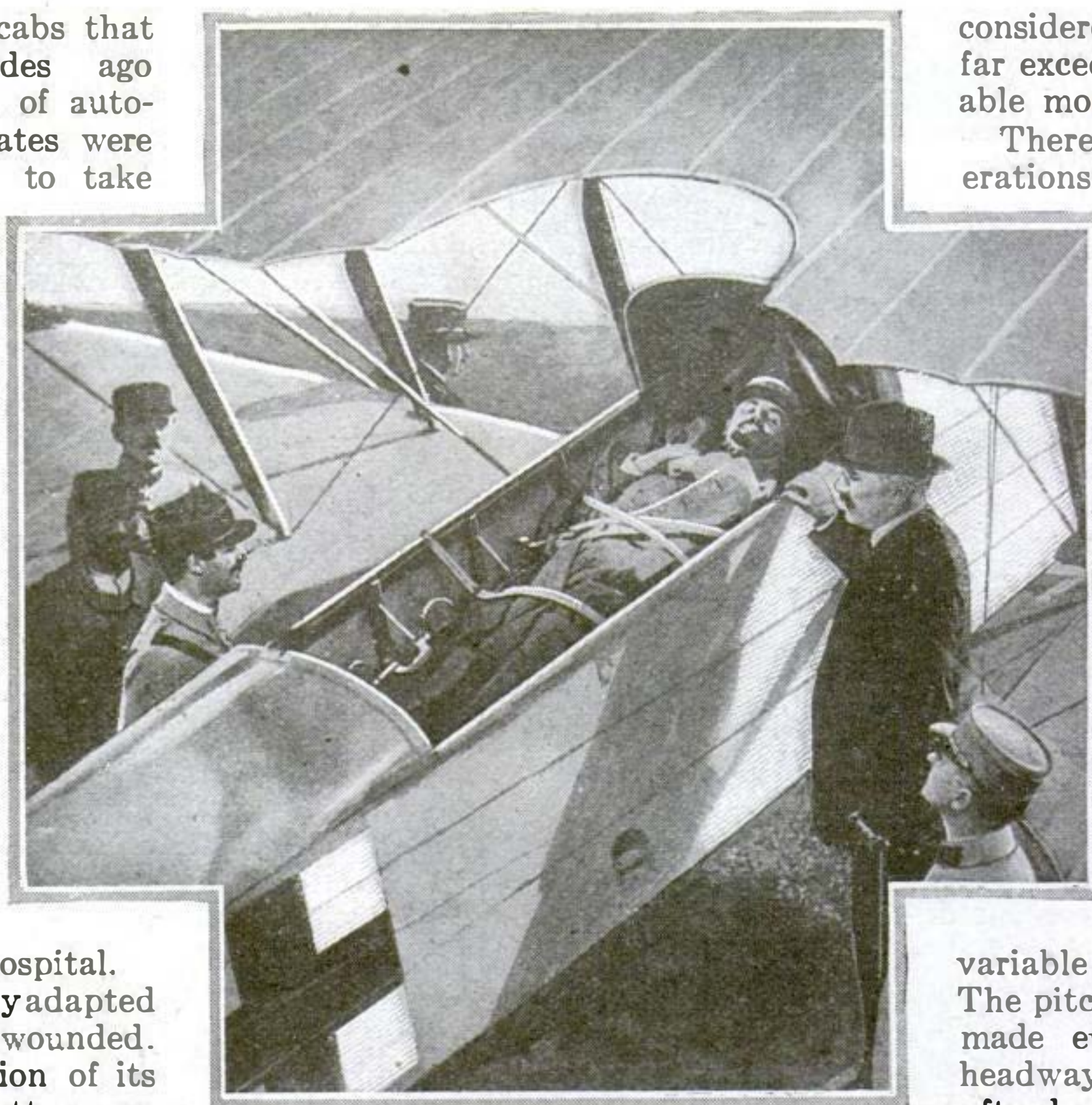
"I remained conscious from 11,000 feet, the height at which we were attacked, down to 5,000 feet. After that, everything quickly became black. What happened after I lost consciousness was told to me by an officer who risked his life by crawling from the British front-line trench to the spot where my machine hit the ground, some four hundred yards out in No Man's Land"

France Comes Forward with the Aerial Ambulance

THE clumsy electric cabs that almost two decades ago inaugurated the era of automobiles in the United States were soon used by physicians to take patients home after an operation. It was recognized that the automobiles moved more smoothly than any horse-drawn vehicle.

The commercial exploitation of the flying-machine seems hardly more advanced to-day than was that of the automobile in 1897. But the accompanying illustration shows that a beginning, at least, has been made to employ the airplane for the transportation of seriously wounded soldiers from the battlefield to the nearest base hospital.

The airplane seems ideally adapted to the transportation of the wounded. The slight, steady vibration of its motor, softened by the mattress on which the patient rests, is harmless, and there are no bumps and jolts. Unfortunately, airplanes are costly, and their carrying capacity is limited. On the other hand, it must be



© Underwood and Underwood

One of the airplane ambulances that the French propose to put into service for transporting seriously wounded soldiers from the battlefield to the nearest base hospital. They do not bump or jolt, and the slight vibration of the motor is harmless

considered that their great speed far exceeds that of any other available mode of transportation.

There are some technical considerations that must be taken into account. The best warplane does not make the best ambulance. The warplanes of today are highly perfected only for their respective military uses.

An ambulance, however, must be specialized solely for starting and landing safely on rough, torn battlefields. This requires a wing profile of maximum lift at slowest speeds and highest flying angles, and a propeller of maximum "standing pull."

Here the importance of the propeller with variable pitch becomes paramount. The pitch of the propeller should be made even reversible, to stop the headway of the machine directly after landing. Airplanes resting on their wheels are already made to offer their wings at a high angle of maximum lift at slow speed. With a reversible propeller, these wings would readily stop the airplane.

What Is Your Chance of Being Killed in One of the Battles of This Great War?

DR. L. BILLON is a French physician who has made a study of the human body from a strictly military standpoint. He has mapped out all its more vulnerable regions, and shown where a soldier may be shot or bayoneted without necessarily being killed. But that doesn't tell a man what his chances are of coming alive out of a battle.

Despite the reports that whole regiments have been wiped out of existence, death comes to but a small percentage. It has been estimated that after twenty-five per cent of a body of troops have fallen the rest will retreat.

It is very rarely that anything like this critical twenty-five per cent is attained. In past wars the lowest death-rate in battle was the .46 per cent recorded for the Spanish-American War of 1898, and the highest was 12 per cent, which was the Russian record for the Crimean war of 1854-1856.

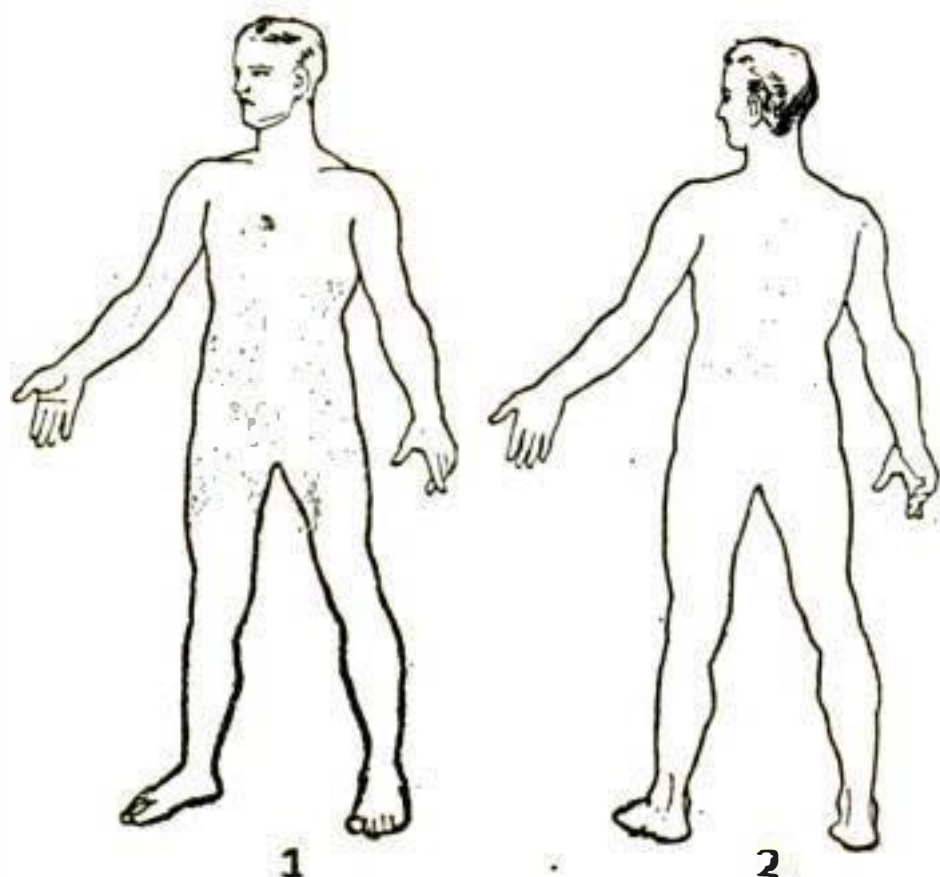
But, if we may judge from the figures compiled by the French, despite the deadly machine-gun, despite the millions of shells fired during a prolonged battle, despite the frightful gas-shells, a soldier's chance of coming out of an engagement in this war are better than they ever were.

According to these statistics, the total French losses for the first five months of 1914 was 5.41 per cent; for the year 1915 they decreased to 4.07 per cent; by the end of 1916 they had been reduced to the astonishingly small ratio of 2.7 per cent. As a mat-

ter of fact, these percentages are extraordinary, because

they allow not only for the killed but also for missing and prisoners.

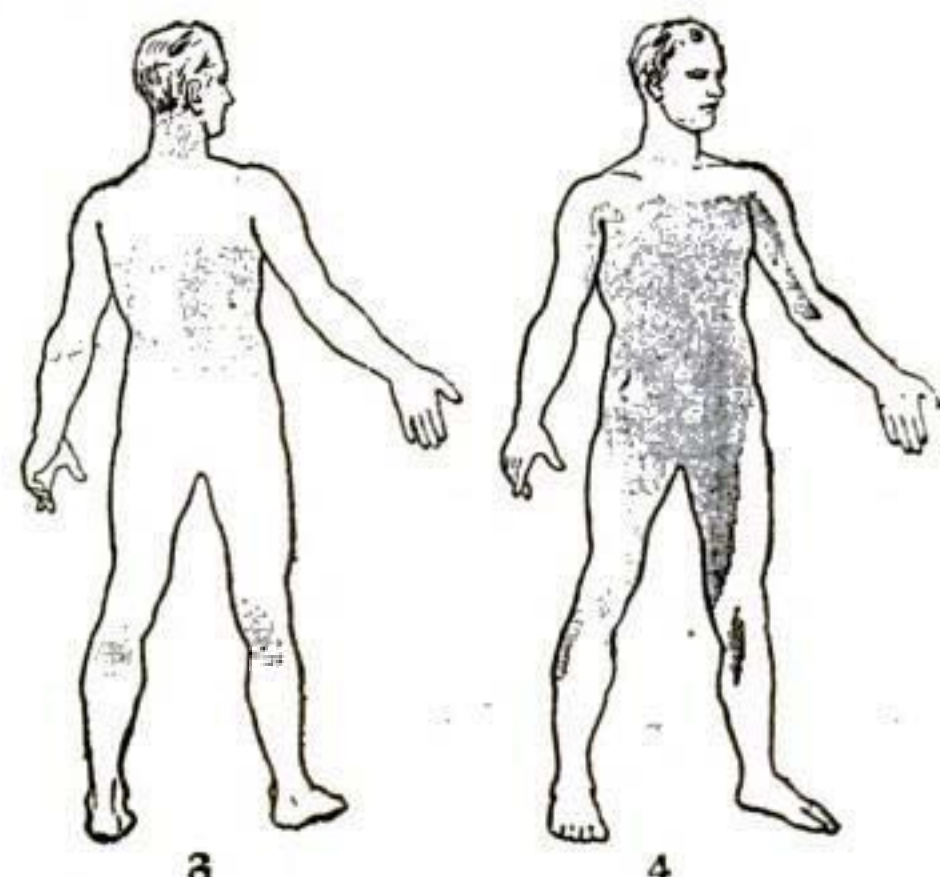
On the other hand, the British seem to have suffered more severely, probably because they had not developed the art of self-protection so early. During the first year of the war the British losses varied from .3 per cent to 13.3 per cent. Correspondents reported that the "Princess Pat" regiment of Canada was practically destroyed. Now we learn that it lost but 12.2 per cent of its officers and 9.1 per cent of its men.



1

2

A distinguished French surgeon, Dr. L. Billon, made these pictures to map out the dangerous parts of the body. If a soldier receives a blow that produces a contusion in the area shaded in Figures 1 and 2, he is killed or crippled. If shot or stabbed in the areas indicated in Figures 3 and 4, he falls dead or badly injured.



3

4

Gassed!

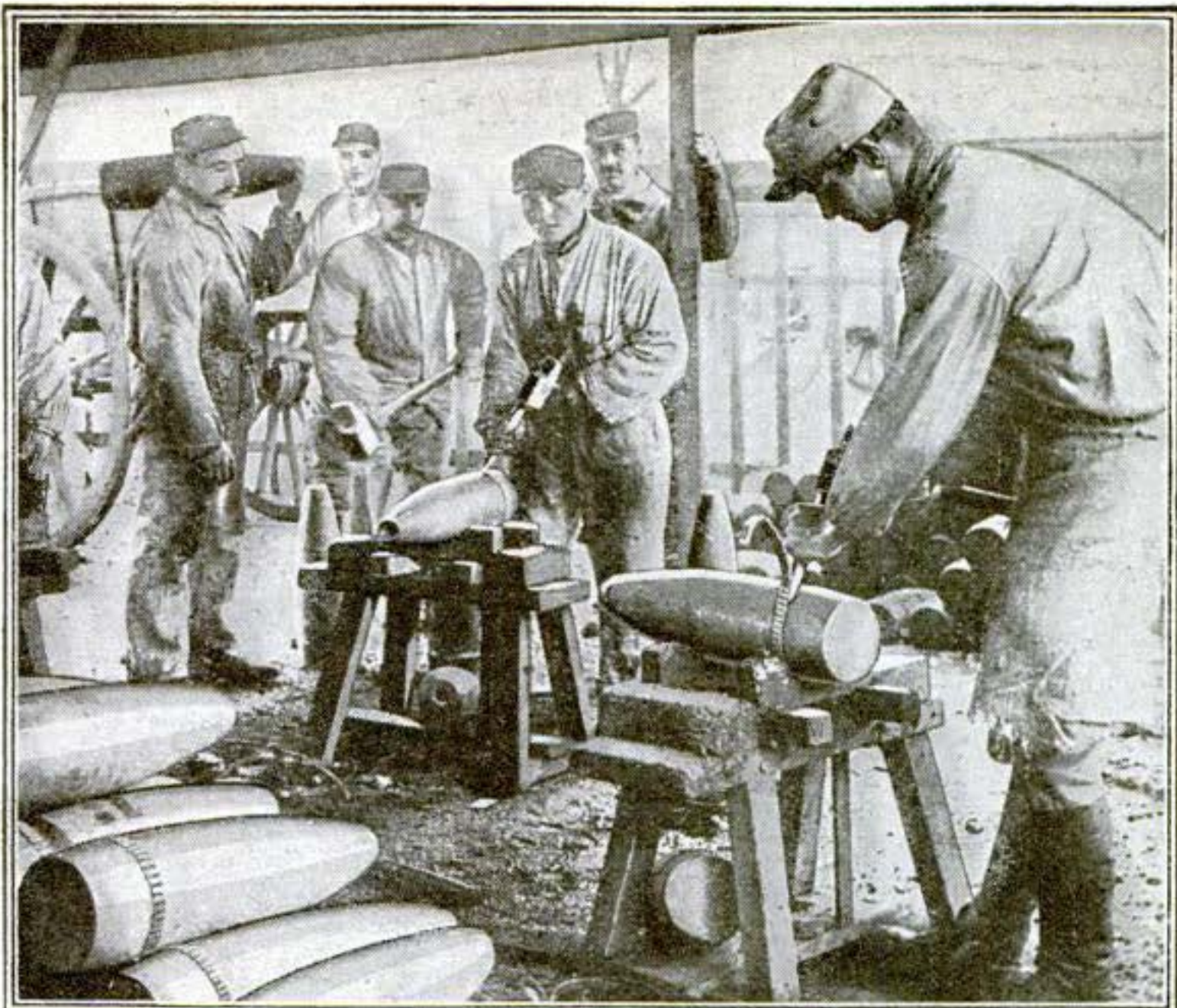
NO one has yet adequately pictured the horror of gas warfare. A foul vapor envelops everything, gnaws its way through clothing and human tissue, blasts the foliage on trees, turns even rifles red. Men die in convulsions, or are so disfigured that they are unrecognizable. They run about, wringing their hands and frothing at the mouth.

It was in April, 1915, that the Germans introduced this cruelest of all weapons, in violation of the Hague convention. At first chlorin was used. It was stored under high pressure in cylinders and released in a cloud when the wind was right. But pure chlorin wasn't cruel enough; it is too easily absorbed. And so the Germans turned to phosgene.

So rapidly is the art of killing improved in this ghastliest of wars that the method of launching gas in clouds has given place to the gas-shell, fired with great accuracy by ordinary artillery at positions that cannot possibly be reached by the wind alone. About twenty different kinds of gas have been developed by the Germans. The one that we hear about most frequently is "mustard gas," which in laboratories rejoices in the monstrous name "dichlorethysulphide."

Strangely, this is not a gas at all, but an amber liquid of a sweetish odor, which does not evaporate any more readily than turpentine. It kills by contact. Unlike phosgene, it lingers for days. Let but a drop of it work its way through a uniform, and it burns deeply into the skin. It can be inhaled without immediate bad effect; but in a few hours a fever sets in, and the lungs literally rot.

Terrible as mustard gas is, it is apparently not terrible enough for the grim business of this war. All the army chiefs have passed along this mandate to their chemists—not in so many words, but by implication: "Find a gas that is odorless, colorless, and highly poisonous, and that will kill a man even if he does wear a mask."



© Underwood and Underwood
Rejected shells are not wasted. They are dismantled, and even the copper bands around the projectile are saved

Every Rejected Shell Is Conserved

IN all belligerent countries great care is taken in inspecting and testing the shells turned out by the munition factories. Special commissions of experts, appointed by the military authorities, are intrusted with this task, after the factory experts have done their part.

The rejected shells are sent to a shop where expert workmen take them apart. The brass case containing the propelling charge, the time-fuse, and the detonator are removed. The explosive charges and fulminate caps are taken out with great caution, and are used again in other shells. Nothing is wasted; even the smallest scraps are again utilized.



Because "mustard gas" eats its way even through clothes, gas-masks are inadequate. A special uniform had to be invented as well

Why the Munitions Industry Knows No Holidays

MILITARY writers estimate that there are, at present, about seven million men in the Allied armies. It is a conservative estimate that each man in the trenches taking part in the skirmishes on quiet days fires, on the average, fifty shots—a total of 75,000,000 rounds. On active days the consumption of munitions increases enormously. The number of shots fired from many small arms on some days runs well into the millions.

About a year ago it was stated that there was one machine-gun to every ten men at the front. The firing ability of machine-guns varies considerably, but five hundred shots a minute is a fair average. Of course, that speed of firing cannot be maintained indefinitely. After a few minutes' firing the gun must cool off.

If we estimate that the number of shots fired from machine-guns and small arms during a drive is 1000 for each man, the consumption of small-arms ammunition would reach a billion rounds.



© Press Illustrating Service

Tons and tons of cartridges are made for the Allied armies. On a "quiet" day these armies fire a total of 75,000,000 rounds

How to Get More Out of Your Car

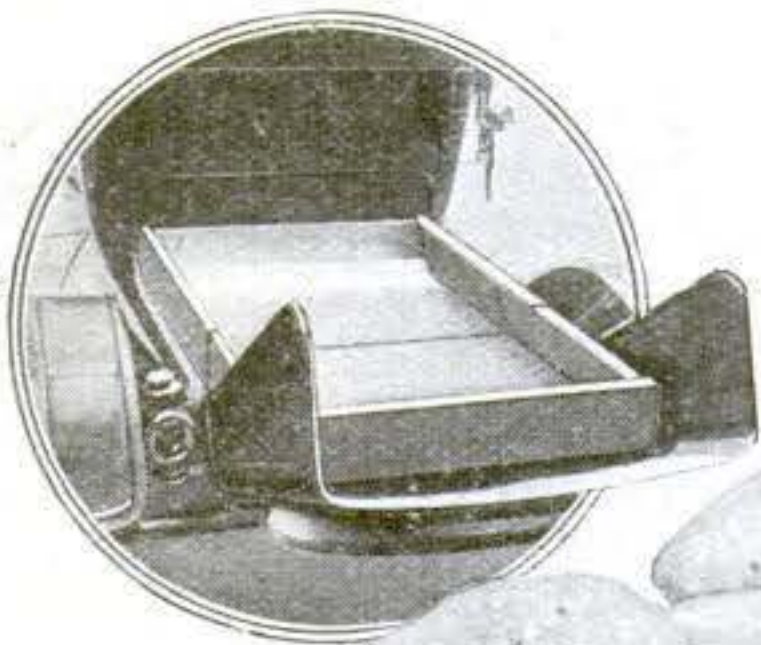


Automobile Stove Heated by Exhaust

COOKING on the road is made possible by an automobile stove placed on the running-board and heated by the exhaust from the engine. The stove is sheet steel, with the heating compartment all around it. The back pressure from the muffler serves to force the exhaust through the stove. A valve in the pipe between the exhaust pipe and the stove turns the heat off and on at will. Dinner may be cooked while the car is bowling along at thirty miles an hour.

Turning Your Ford into a Wagon

ONE of the most ingenious dual-purpose bodies yet designed to convert a Ford roadster into a delivery vehicle, consists of a metal telescoping load-pan inserted under the usual Ford rear apron. The load-pan remains permanently in place, and is unrecognizable when closed. It can carry 1800 pounds.



How Would You Like the Life of a Gypsy?

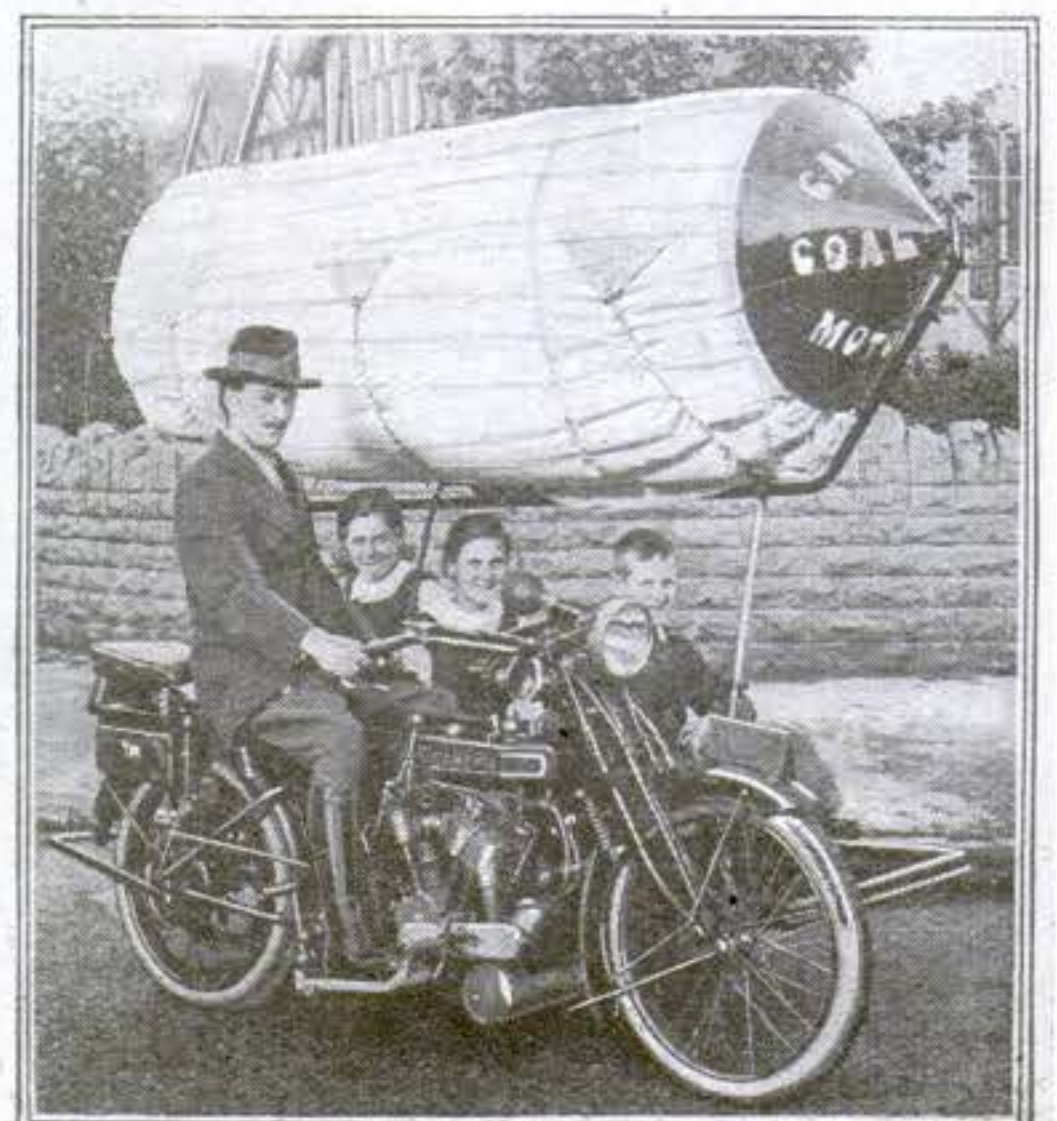
Tmost of us the freedom of gypsy life appeals more or less. To be free from all care and conventionality, sleep when you wish, eat when you like, and spend your time as the spirit moves you—what could be more desirable? And if you are rich enough to afford an automobile and one of those new-fangled trailers that unfold into a large and comfortable tent with all the comforts of home, you can eliminate all the drawbacks of the ordinary gypsy life.

The trailer runs on two wheels, is eight feet long, four feet wide, and weighs about 750 pounds. It carries a big waterproof tent, two folding beds with mattresses and blankets, an ice-chest, a folding table, and a folding camp-stove with all necessary cooking utensils. The tent is permanently attached to the trailer, and unfolds like the top of an automobile. One person can set it up in about ten minutes.

Run It on Coal-Gas

IF you want to cut down your gasoline bills, give up gasoline and use coal-gas for fuel. The cost of petrol has risen so high in England that some substitute had to be made if people were to continue to run motor vehicles. That substitute seems to be coal-gas. It costs about one third as much as petrol.

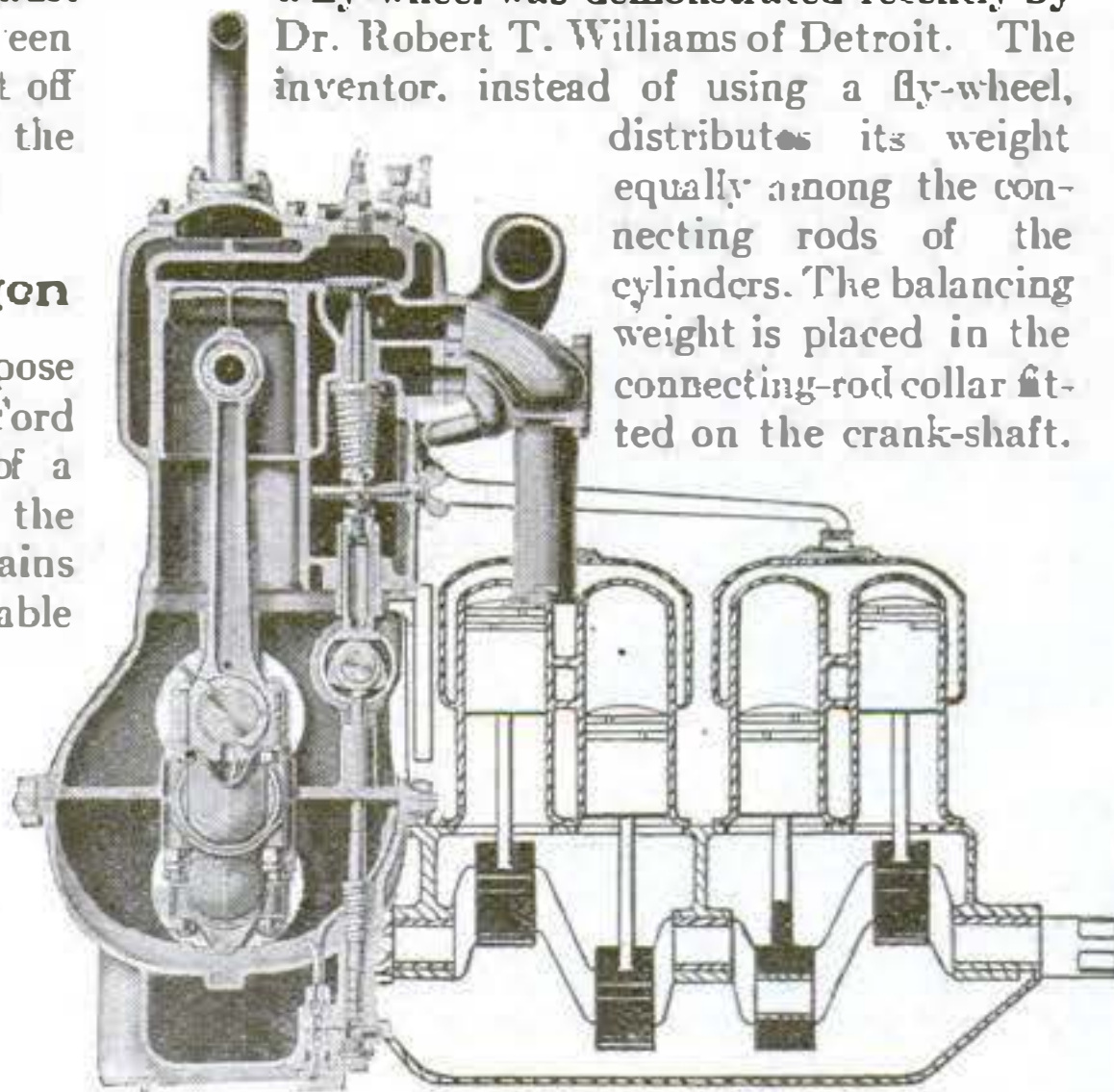
The greatest difficulty in using coal-gas for motorcycles is the question of storage.



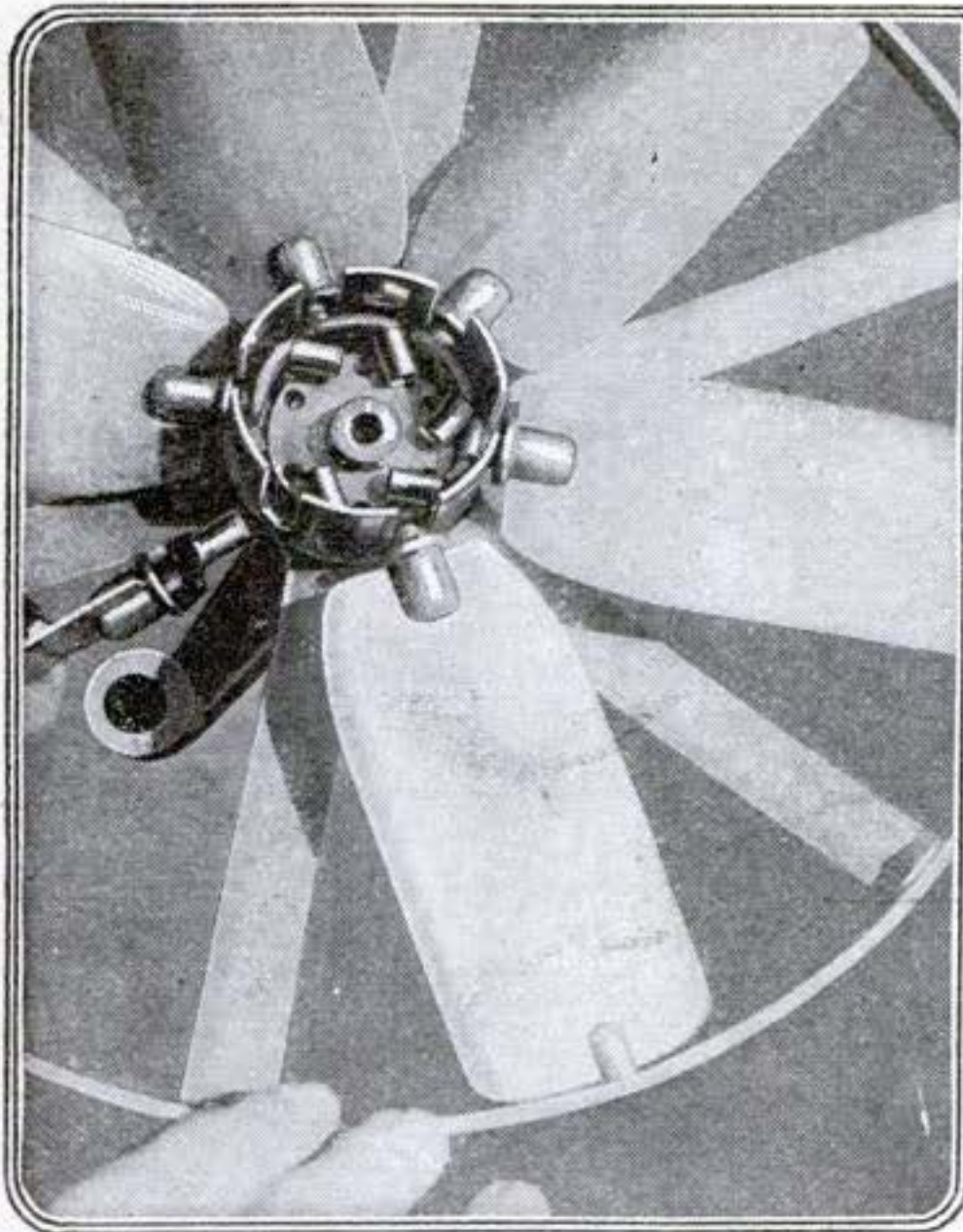
Doing Away with the Fly-Wheel

THAT an automobile engine with four or more cylinders will run smoothly without a fly-wheel was demonstrated recently by Dr. Robert T. Williams of Detroit. The inventor, instead of using a fly-wheel, distributes its weight

equally among the connecting rods of the cylinders. The balancing weight is placed in the connecting-rod collar fitted on the crank-shaft.



Try These Out on Your Automobile



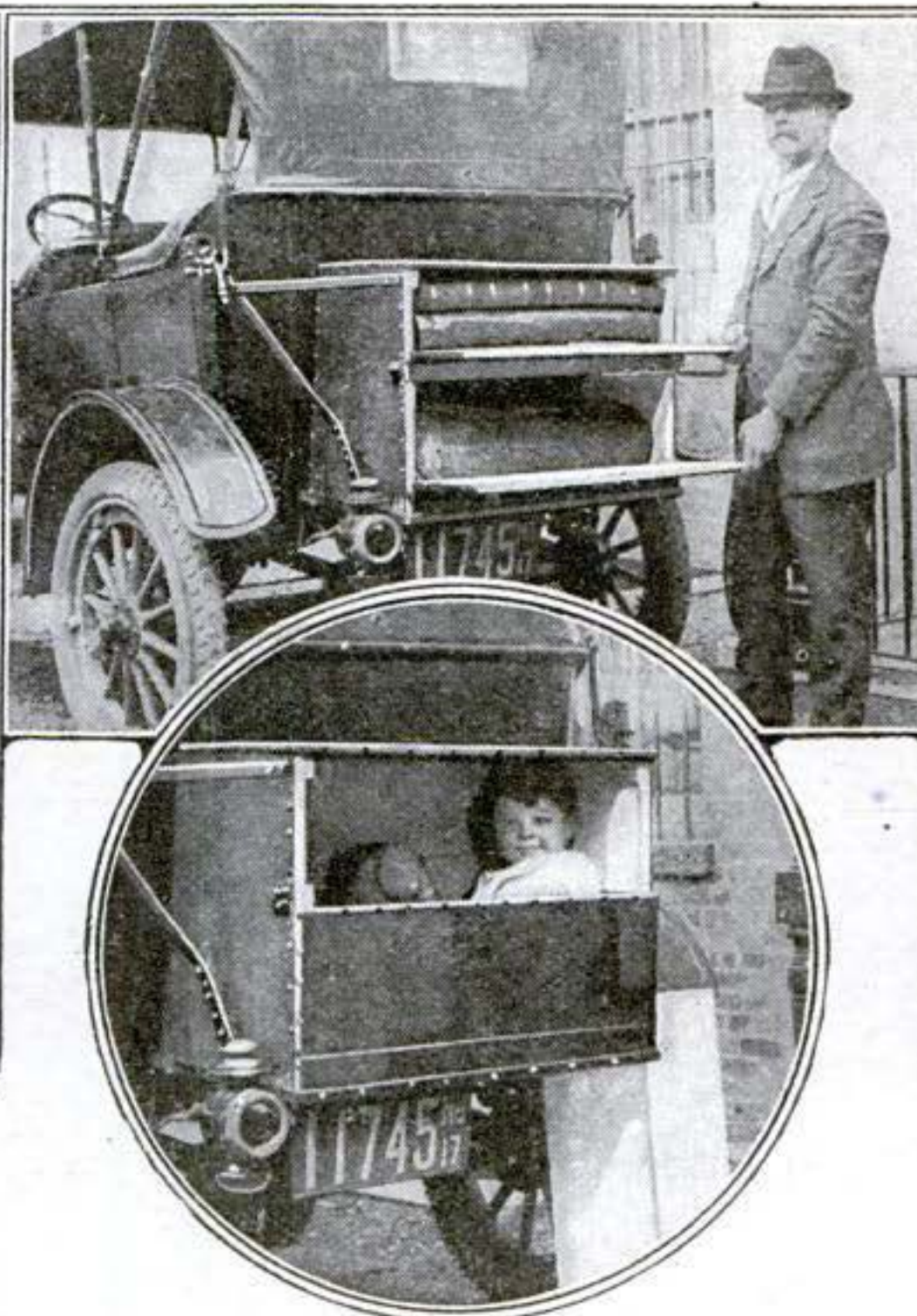
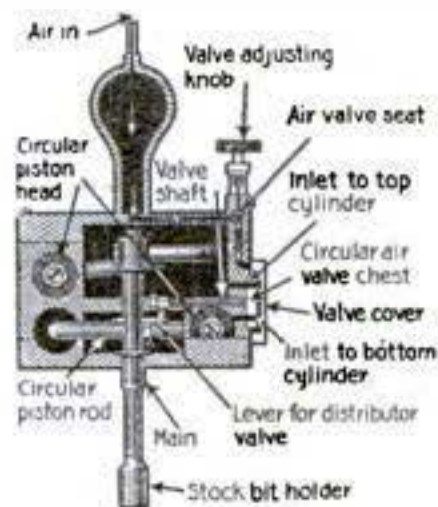
Adjusting Blades of Fan while Running

THE engine of an automobile or an airplane should be kept at a uniform temperature. In hot weather the engine must be cooled, in cold weather warmed—all practically by the same means, a water-jacket and a rotary fan. W. G. Weatherly, of Peola, Washington, has invented a device for changing the pitch of the blades of a fan while it is running.

The fan is surrounded by a frame or rim. The outer ends of the blades are pivoted in bearings in that rim. The inner ends of the blades are fastened to cranks, the handles of which rest between two disks which can be operated by a shaft controlled from the driver's seat.

A Pneumatic Valve-Grinder

A PNEUMATIC valve-grinder has recently been put in the market. The mechanism is contained in a cylindrical casing of die-cast aluminum about four inches in diameter and two and one half inches high. At one end is a swelled handle, to the free end of which an air tube is attached. The air, under pressure of from fifteen to one hundred and fifty pounds, passes through the hollow handle to the valve-chamber, and presses against the packed pistons attached to piston rods.



A Carry-All for Tourists

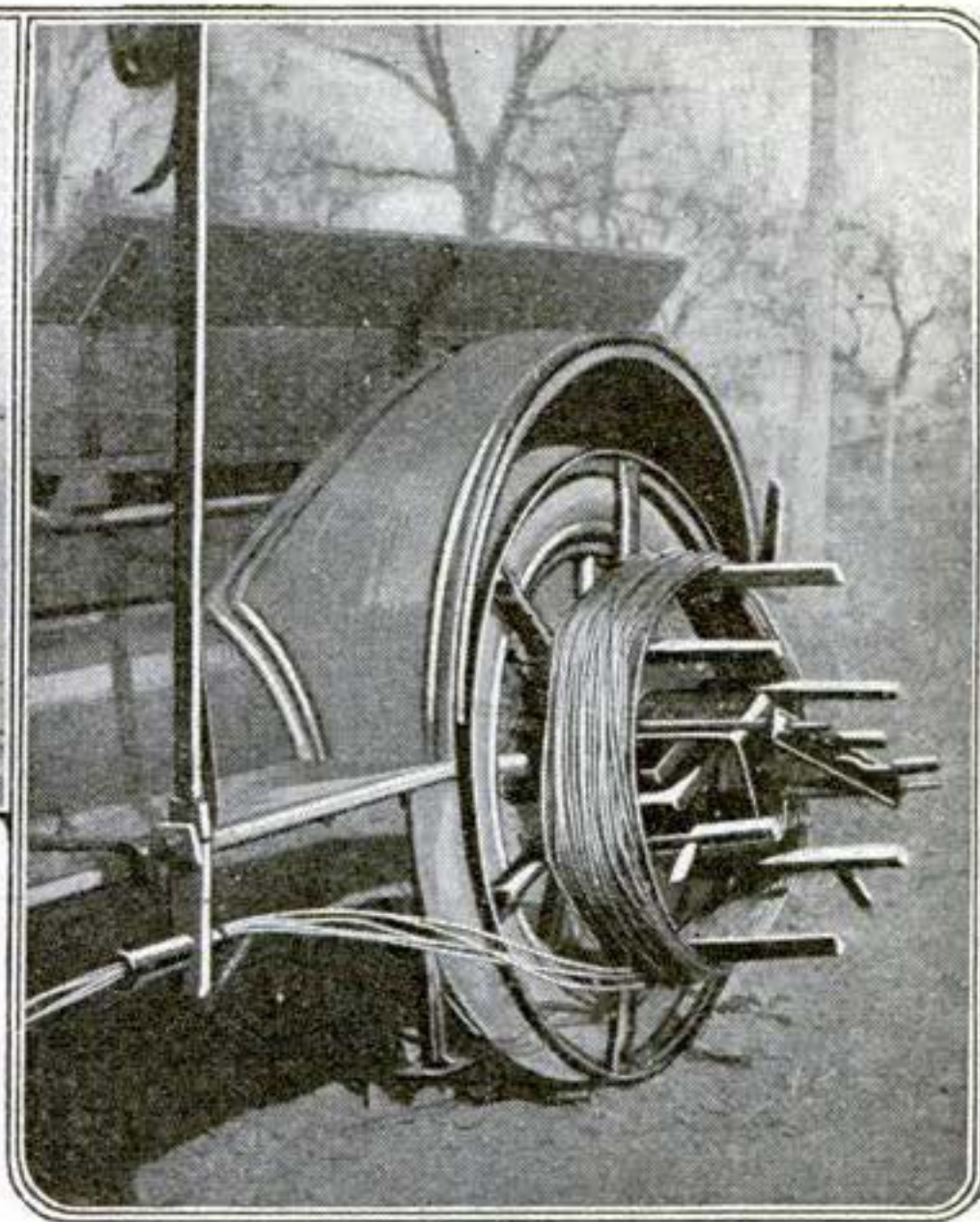
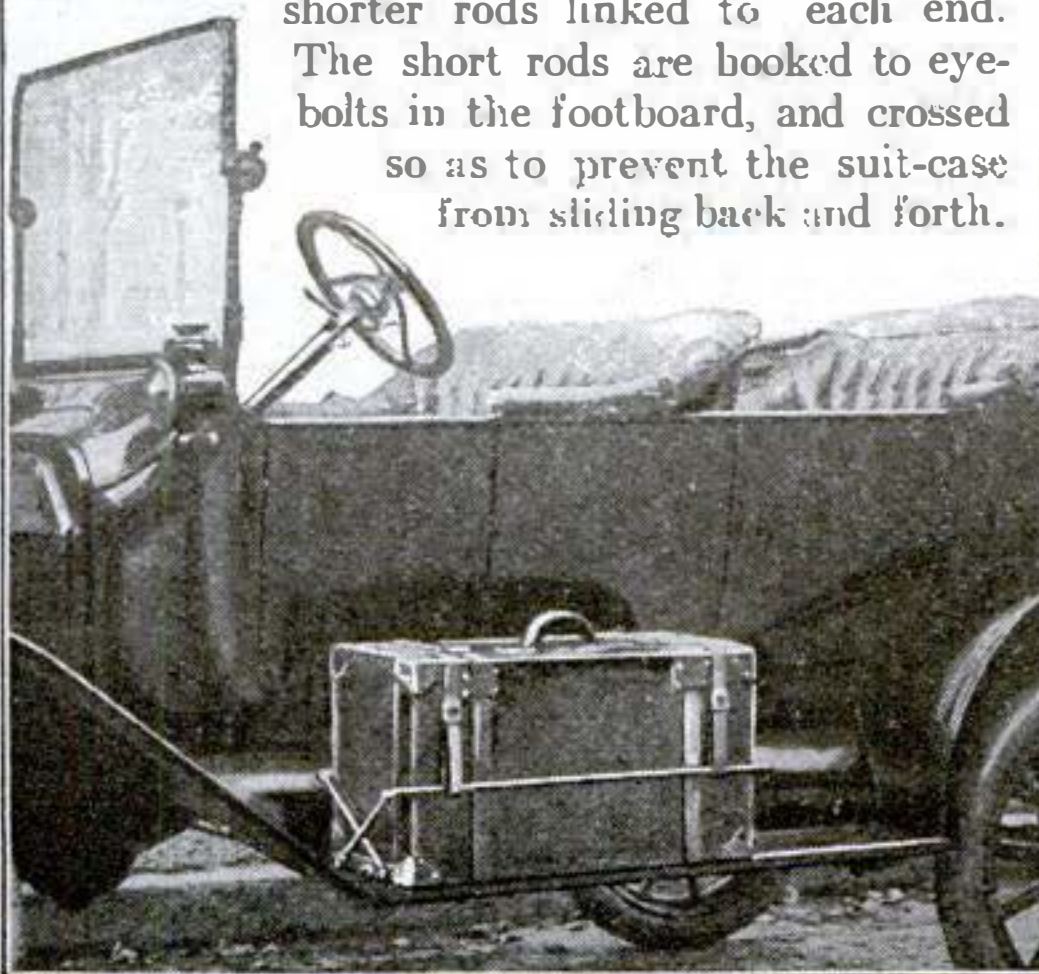
A CARRY-ALL has been invented by Charles C. Eli, of West Hoboken, N. J. It is a boxlike cabinet with one removable shelf, and is attached to the rear end of the automobile. The cabinet rests upon a bracket, and is large enough to hold blankets, clothing, provisions, etc. The doors of the cabinet are so arranged that they can be turned down to form a table.

A Collapsible Suit-Case Holder

DID you ever ride in an automobile with a suit-case at your feet on the floor of the tonneau? Do you remember how you tried every possible way of wrapping your legs around the suit-case without striking a single position that you could maintain in comfort for more than a minute at a time?

All you needed for your comfort and peace of mind was one of the collapsible suit-case holders shown in the accompanying picture. It will hold a suit-case, lunch-basket, or luggage-carrier on the running-board of the automobile, and

when it is not needed it will fold up into a small parcel that may be stowed away under the seat-cushion. Two iron or brass rods have shorter rods linked to each end. The short rods are hooked to eye-bolts in the footboard, and crossed so as to prevent the suit-case from sliding back and forth.



Make Your Automobile Engine Do It

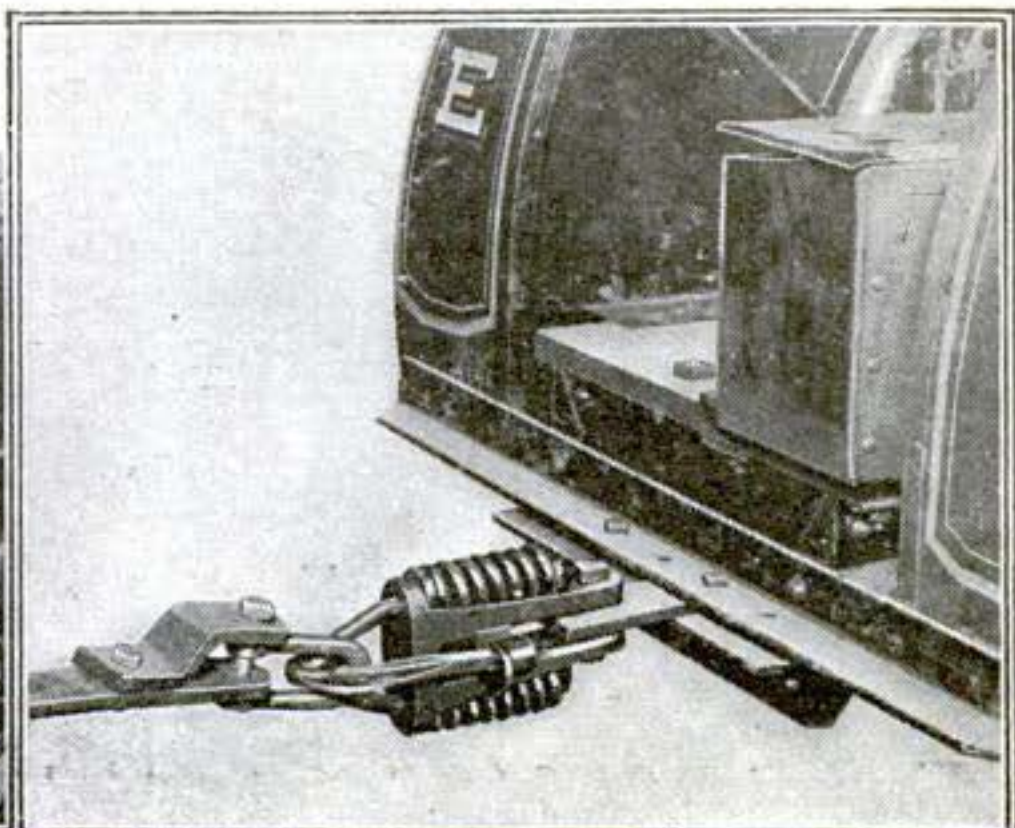
A REEL that can be attached to an automobile has been introduced to facilitate the rolling up or paying out of wire. For take-up use, the reel is attached to the rear wheel of an automobile that has been jacked up. This operation requires no tools, and can be performed quickly.

When the Tractor Strikes a Rock

WHEN a plow runs against any obstacle a horse will stop, but a tractor continues to pull. To prevent the breaking of the plow points in such a case an automatic clevis hitch has been invented, which under great strain disconnects the plow from the tractor.

The device consists of a yoke-shaped casting with two flat parallel arms placed horizontally, with the open end toward the tractor. A bolt through the tractor whiffletree and the open ends of the yoke hold the two parts together. Powerful coiled springs rest against the flanges of the yoke on the outer side of each arm. Through holes in the flanges of the yoke run the arms of a U-shaped clevis hook, which pass through the spring coils and have plates riveted to their ends, which rest against the front ends of the springs.

The clevis of the plow is attached directly to the U-shaped clevis resting upon the springs, but indirectly by means of a clevis arm pivoted to the closed part of the U-shaped hook. When the tractor pulls the plow, the resistance of the plow will cause a compression of the springs. If the pull reaches a certain maximum limit the end of the clevis arm slips out and releases plow.



The Home Gymnast Entertains His Friends

By R. P. Staats, 2d

BEFORE trying any of these tricks, *make sure of your chair.* It must be a heavy, stout one that can't wobble. The kind often described as a kitchen chair will generally fill the bill; and a straight-backed, heavy "Mission" chair is ideal. The rear legs should form the sides of the chair's back—that is, they should extend up through the chair seat. The cross rail at the top of the chair's back should be straight and horizontal. Personally, I prefer a solid wooden seat.

Next, be sure that your chair is standing on a rug or carpet, which will keep it from slipping and at the same time serve as a mat. While learning, it is well to wear light shoes or "sneakers" and as little clothing as time and place permit. Make sure, too, that you have a clear space of four or five feet around your chair; furniture close to you is a mental as well as physical handicap.

Short-Arm Stand. Take your position facing a side of the chair, and from twelve to eighteen inches away from it. Now lean forward so that the "heels" of your hands rest upon the near edge of the chair; to do this you must hold your elbows close together and turn back the hands so that your fingertips point toward your body. Your hands should rest on the chair about three or four inches apart, and your thumbs rest on the chair bottom, pointing slightly in from its edge, while your fingers grip the edge and under side of the seat. Now bend the arms at the elbows so that the pit of your stomach rests upon your elbows.

By stretching out your neck and expanding your chest, you will find the body is in sufficient balance to permit the legs being raised to the horizontal position shown in the figure. Equilibrium is readily maintained by regulating the position of the head, and by down pressure of the thumbs. To hold the body in this rigid pose, parallel to the plane of the floor and at right angles to the forearms, will be a tax on the muscles. Don't hold it too long.

The one disadvantage of the Short-Arm Stand is that it is an awkward trick to get in and out of. The performer is too apt to fall forward on his hands clumsily, and make the raising of his body into line seem simply a "muscle-grind" and not a graceful acrobatic trick.

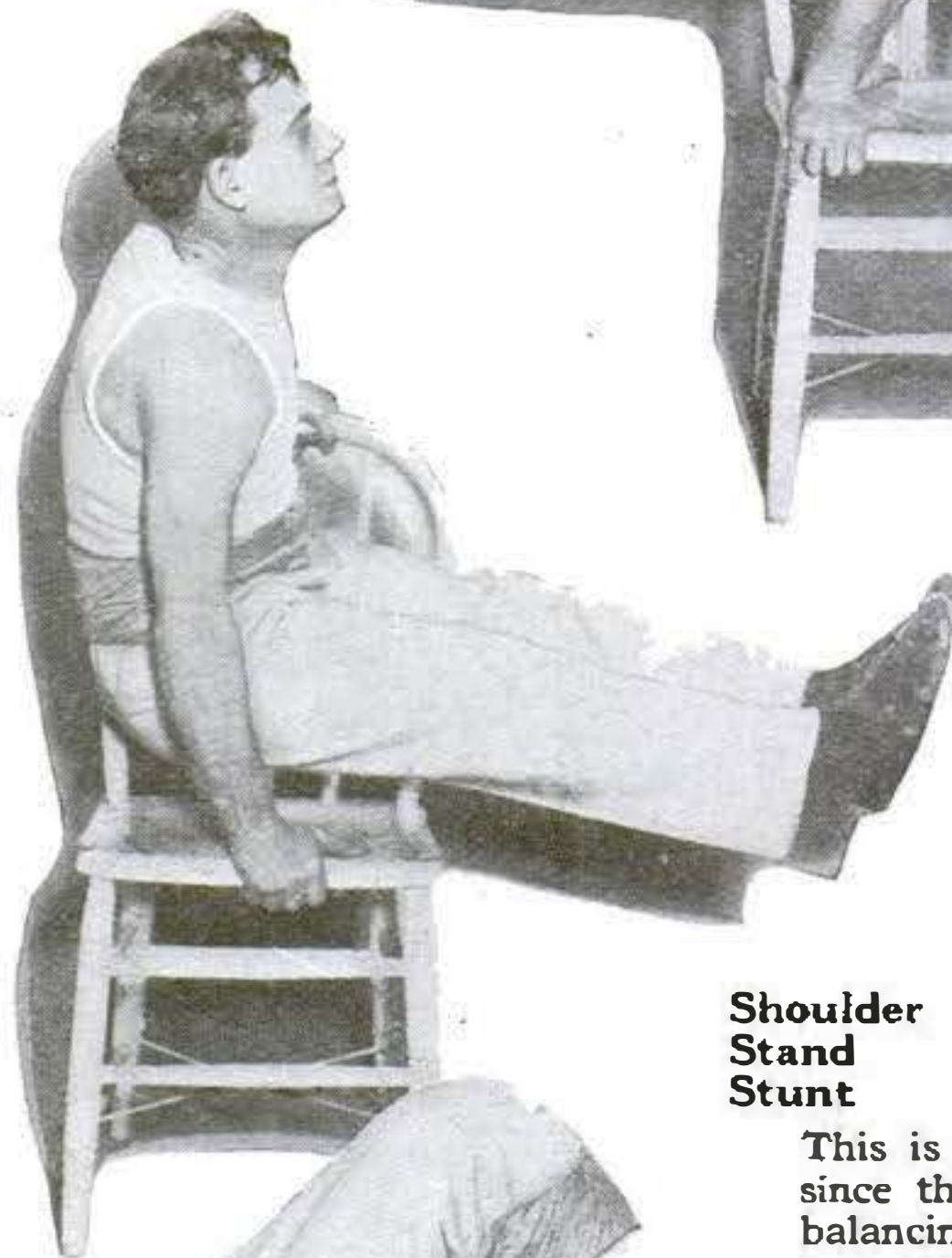
Head Stand on Chair. This looks dangerous, but isn't. Until you have mastered it, however, it is wise to have a friend steady the chair to guard against the possibility of an upset. Directions for this trick are given with its two pictures on page 57.

Chair-Roll. Sit a-stride the chair, facing front, toes resting on floor close beside the chair's back legs. Now bend forward and grab the front legs at the very end, so that the forefinger and thumb of each hand will be *next to the floor.* This hand hold is important, for you must be able to press the sides of your clenched



Short-Arm Stand

A good stunt for the beginner, developing the stomach muscles and the sense of balance. Before you start be sure that you have the right kind of chair to work with



Shoulder Stand Stunt

This is not an easy chair trick, since there is danger of over-balancing. Have somebody you can rely on stand by to steady the chair, until you have mastered the stunt, and use great care in raising yourself to the final position. At the conclusion of the shoulder stand, lower your body slowly to its original sitting position



Final position of shoulder stand



Head-Spring Over

A heavy stool or bench should be used for this; and make sure to have plenty of space around it. Follow the directions carefully

A Kitchen Chair Is All the Gymnasium He Needs

Illustrated with photographs of Bluch Landolf of the New York Hippodrome, who posed for the Popular Science Monthly

hands on the floor sufficiently hard to support the weight of your body as it rolls forward and out of the chair. Duck the head well in so that it will simply touch the floor, and all impact—or as much as possible—will be sustained by the back of the neck and shoulders. Now, as the body pitches forward, give a slight push with the toes to help the thing along and to insure your legs following the body in smooth sequence. When your back is fairly on the floor, contract your stomach muscles so as to slow up the sweep of the legs and permit them to come down extended and close together, to a position flat on the floor.

Now comes the rolling back into the chair. Whip the legs and back up into (approximately) the second position (see picture at right, below) by a strong contraction of the stomach and abdominal muscles. The impetus gained must be instantly aided by a powerful "snap" from neck and shoulders (accomplished by a sudden straightening of the neck), and the whole thing finished by a down push and straightening of the arms. These separate efforts, when timed correctly, will readily throw the body back into the original sitting posture if the legs are spread at the right moment.

Head-Spring Over. First, make sure the stool you use for this stunt can't slip. Take three or four quick steps to a "take-off" point beside the stool. Place the hands, palms down, fingers extended, ends of thumbs just touching each other, on the seat of the stool a little *this* side (toward you) of its center. Simultaneously bend arms and neck so that the top of head rests on chair between hands. The impetus of your run, assisted by a spring with the legs, will be ample to carry the body over. But, once past the point of equilibrium, you must shove with head and hands, and whip the body down by sticking out your chest, stomach, and abdomen *hard*; this will insure your landing upright on your feet.

Shoulder Stand. Sit sideways in chair so your left side is against back of

chair. Body should be erect, and feet touching floor lightly. Now raise *left* elbow and grip the chair's top rail (back) with the *left hand* at a point close to your left armpit. With the *right hand* grip the front edge of the chair midway. Raise your body from the chair by a slight straightening of the arms, and draw your knees up to your chest. Lean well forward and draw your legs back between your arms. Lean still further forward, so your left shoulder rests firmly on the top rail. To push up into complete stand will be easy.

The difference between a clumsy performance and a good one is marked by such details as the handling of hands and feet

Chair-Roll

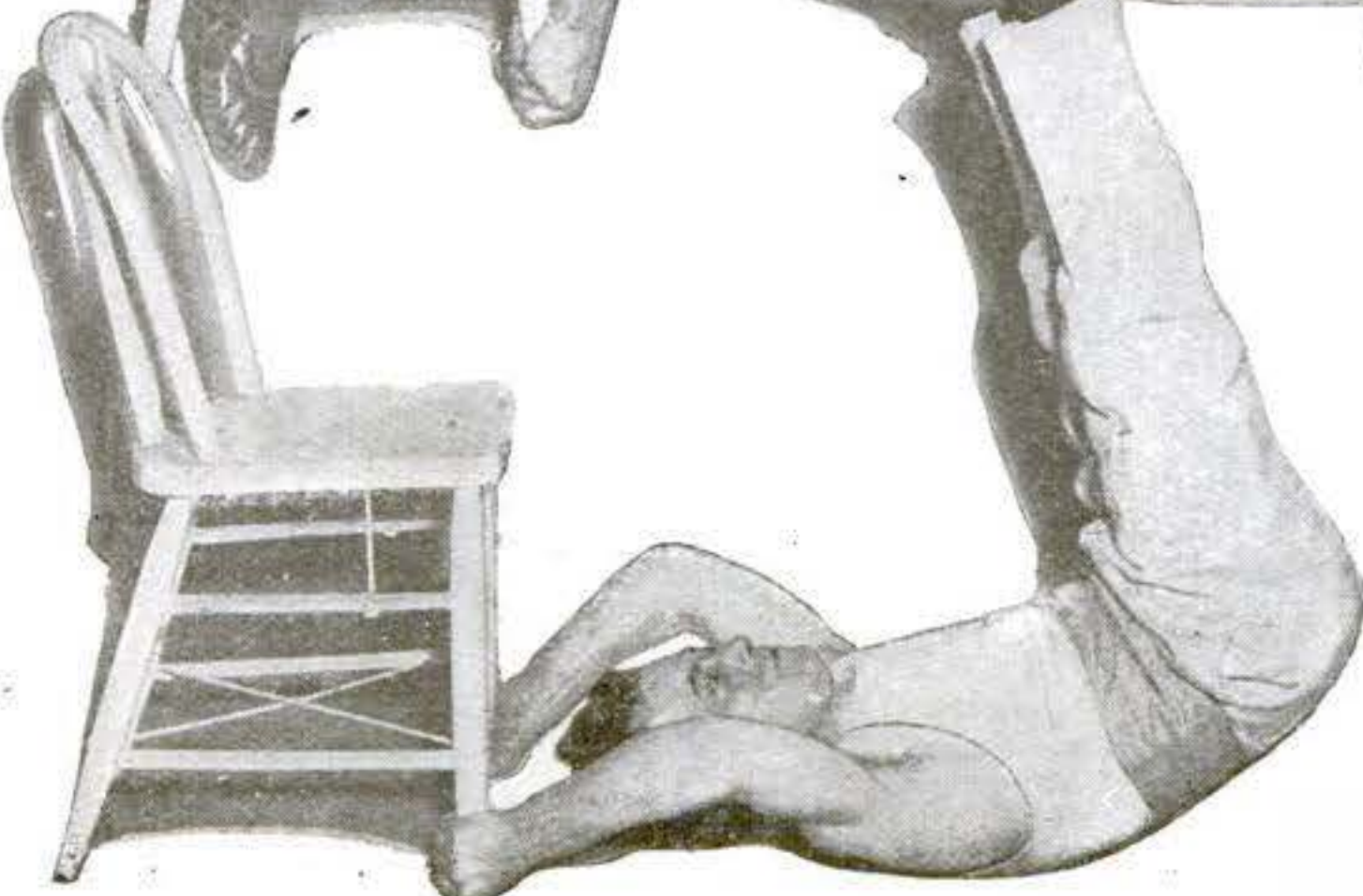
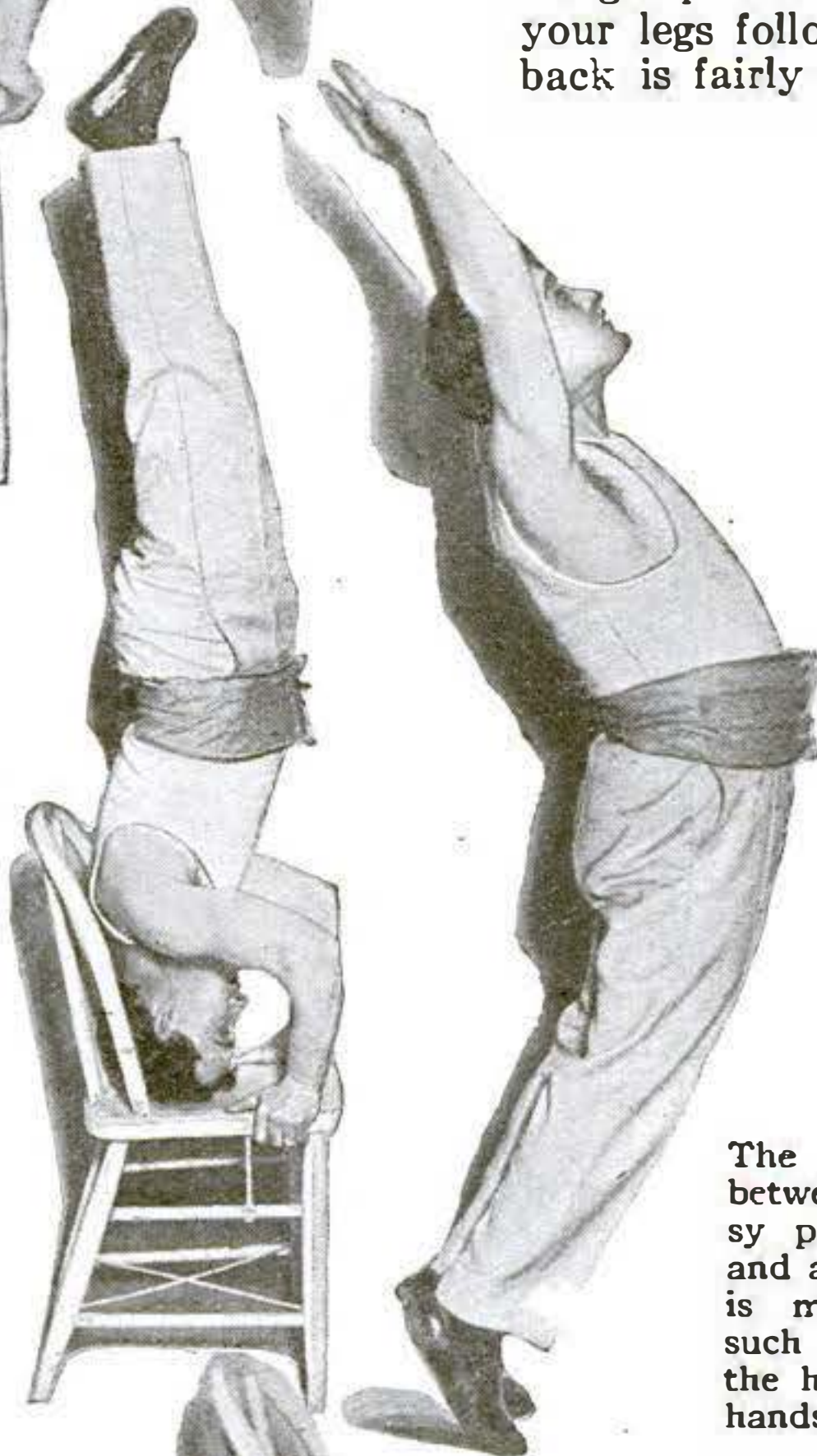
One of the most amusing tricks a tumbler can do, though its accomplishment may involve an occasional bumped head. The first time you try it, pile soft rugs or pillows in front of your chair. You will have to practise this stunt slowly and patiently. There is not much knack about it—you must learn it by trying over and over again

Head Stand on Chair

Face front of chair. Grasp sides firmly close to front legs. Lean forward, elbows pointed out, and rest top of head on chair as far back as possible. Press down with arms and give enough spring to lift feet and permit legs, at a point inside and just above the knee, to rest on elbows.

Hold posture, then slowly and carefully draw knees together and raise legs to a near-vertical position. Do not try to raise yourself into a vertical position.

When lowering the body at the conclusion of stand, omit the half-way stop. Bend at waist, keeping toes pointed. Bend the back. When the toes nearly touch floor, give a down push sufficient to throw you on your feet in an erect position.





Sucking Up Mud by the Wagon-Load

A SUCTION-DREDGE, of the kind used by the engineer in reclaiming swamps and in deepening channels, is primarily a ship that is often more than two hundred feet long, and that is equipped with powerful pumping engines. It can suck up from two to three thousand cubic yards (a cubic yard is equivalent to a dirt wagon's capacity) from a depth of thirty feet, and discharge the material through a pipe to a point on shore a mile away.

A Lever Raises This Wireless Tower

A DEVICE that promises to be of great importance to the field wireless service is a telescopic tower that can be raised almost instantly on the throwing of a lever. This tower, the invention of R. W. Dean, of Des Plaines, Illinois, has been presented to the Government.

The tower that carries the wireless aerials works on an extremely simple principle. A number of light steel pipes fit inside of one another, the space between them being made air-tight by a series of washers at the top of each but the middle pipe. The base-pipe connects with a compressed-air reservoir which is always kept filled by an air-pump operated on the storage batteries of the wireless outfit.

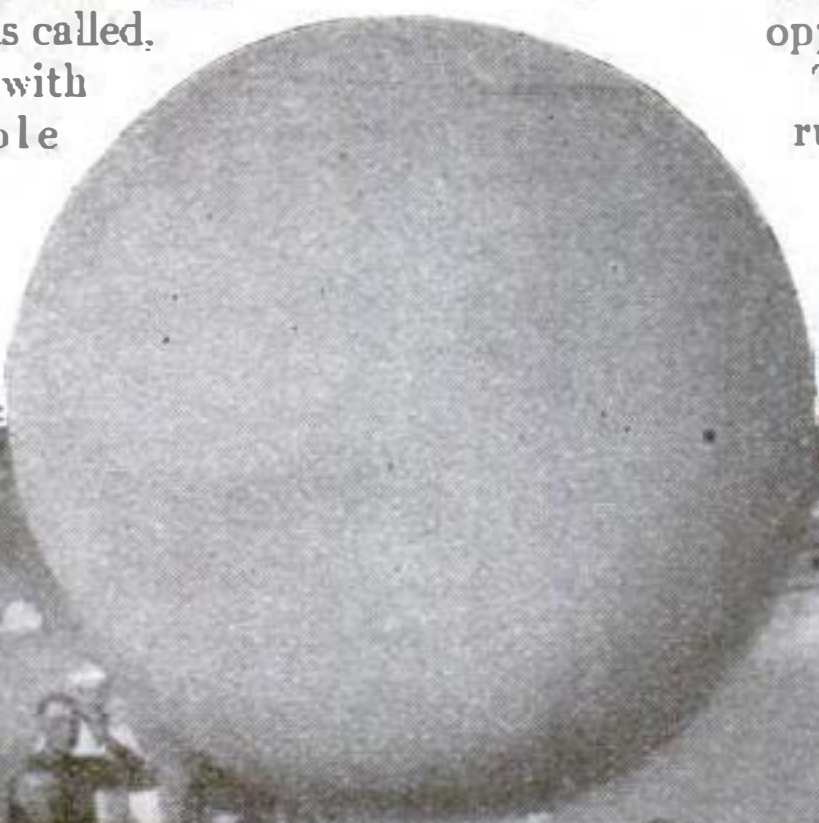
The operators turn on the compressed-air lever. Air from the tank rushes to the top of the innermost pipe, and pushes up on it with a force upward of twenty-five pounds for every square inch of its surface. The sections shoot upward, one after another.



"Clean as a Whistle"

"CLEAN as a whistle" does not apply to the ordinary police whistle. Inspector Joseph A. Faurot, of the New York Police Department, found this out one day when he watched a policeman trying vainly to blow a whistle that was clogged with lint.

Inspector Faurot straightway invented a whistle that is always ready to call for aid whenever aid is wanted. The Faurot, as it is called, is provided with a collapsible safety cap that keeps it clean.



© Western Newspaper Union

Waifs of the Revolving Box in Havana

THIS door is swung wide to admit many an applicant to the care of the Sisters of Charity at the Casa de Beneficencia in Havana. It is set in the convent wall, and is most ingeniously arranged to make things easy for mothers who wish to abandon their children.

When the door opens there is disclosed a revolving box with three compartments—evidently forethought had been taken as to the possibility of abandoned triplets. The mother deposits the castaway in one of the compartments and gives the wheel of human fortune a turn; and the baby's weight sets a bell ringing to summon the sisters.

Cage-Ball to Teach War Spirit

"FOUL! You can't kick the ball," yells the referee, halting a lively game of cage-ball between marines and sailors. Back of the massed players, at either end of the field, is a trough-like basket mounted on two poles. The object is to push, bat, or throw a canvas-covered rubber ball, thirty inches in diameter, into the opponents' cage.

The struggle to do this resembles a college rush. Each side exerts every ounce of strength in pushing the ball onward toward the enemies' cage. One point is scored for each goal made. At the end of thirty minutes the side having the largest score wins.





Photograph by Donald B. MacMillan
Courtesy American Museum of Natural History

Thirsty? Use Your Belt to Get a Drink

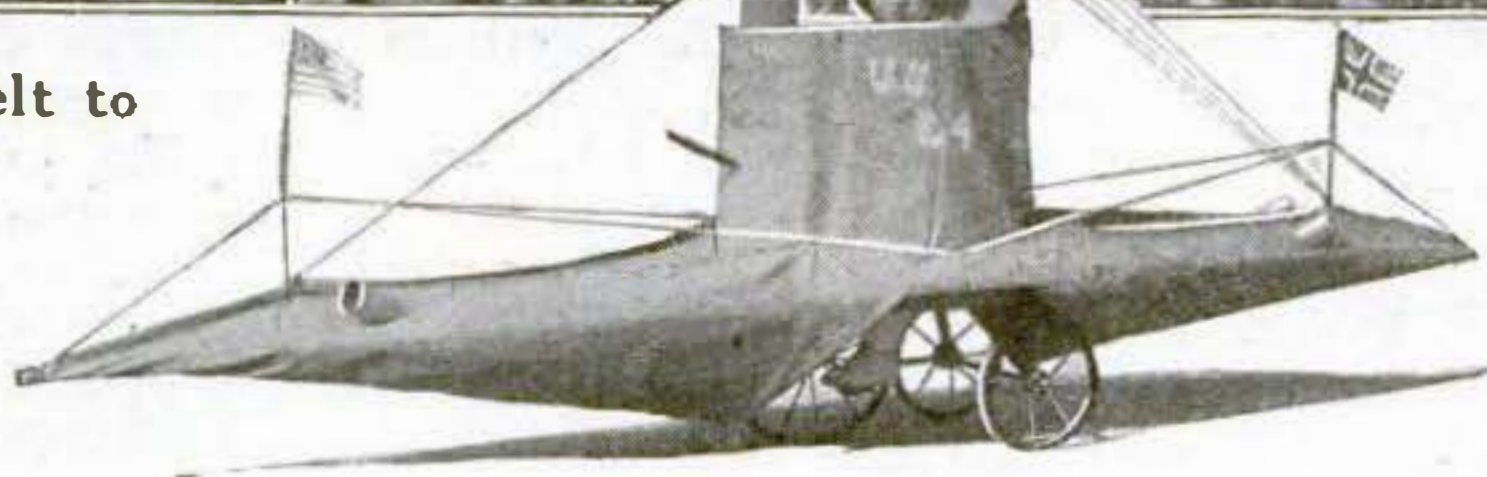
WHEN Oliver Herford comes to a babbling brook and wants a drink, he does not throw himself prone on the mud and try to get water on the vacuum-cleaner principle adopted by the cow, nor does he use his Panama on the Gungha Dhin principle. He might use a straw or a drinking-cup, if he could ever remember to carry them with him. A hundred things he might do, if he could only think of them.

But what really happens? Oliver takes off his belt and winds it up as tightly as he can. The coils are wrapped around one another so that a cone is built up. That forms a cup with a hole in the bottom. Oliver uses a finger as a stopper for the hole, and proceeds to dip up his drink in the fashion set long ago by the first civilized man.

Case for a Luminous Crucifix

TO enable prospective customers to see a luminous crucifix in broad daylight, a manufacturer has designed a curious traveling-case for his customers. The case is of the usual size carried for demonstration purposes; but, instead of a cover, it has a light-proof hood that can be extended like the focusing chamber of a camera.

The crucifix is coated with a phosphorescent substance which absorbs light during the day and radiates light at night. When hung in a perfectly dark room it produces a brilliant light, blue at first, which gradually changes to white. The darker the room the brighter the crucifix shines.



A Boy's One-Man Submarine

SUBMARINE attacks are common in Bath Beach, a suburb of Brooklyn, New York, where young Joel Coheu has constructed a one-man submarine.

The conning-tower, which consists of barrel staves covered with canvas, has two small periscopes made of stovepipe. The whole is mounted on a tricycle. Formidable pastboard guns protrude fore and aft.

Get Out Your Trinkets

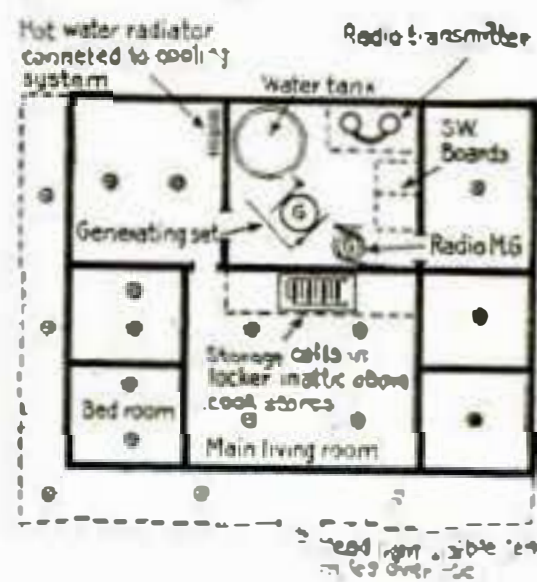
THE Aviation Committee of the National Special Aid Society is collecting family heirlooms, wedding silver, and all sorts of keepsakes, to be converted into money to supplement the equipment the Government allows aviators.

Some of these articles are sold in a shop on Fifth Avenue. But most of the jewelry is converted into gold and silver bars at the Sub-Treasury in New York, and the Society receives its equivalent in money.

Electric Lights in the Cold Arctic

THE nights are six months long up in Crocker Land; but Donald B. MacMillan and his party of explorers on their latest expedition never had to be afraid to go home in the dark—at least, they were certain to have plenty of light once they got there. Instead of sitting in the murky gloom of a blubber lamp, they boasted electric lights. Over the front door of their lodge was a headlight that threw its beams ten miles over the ice.

This state of things was produced by the foresight that prompted Mr. MacMillan to take with him a marine generating set. The plant was installed and run by Ensign Jerome Lee Allen of the United States Navy, who was the radio operator of the expedition.



Eliminating Telephone Noises

A NEW ear-piece of standard size and thread, which will fit on any telephone receiver, is intended to filter out all clicks and rasping, disagreeable sounds which make it almost impossible for the nervous and irritable to use the telephone. It is said that the invention also makes low-spoken words plainly heard.



Fighting Dust with Dust in Coal-Mines

It's in the non-gaseous mines that most of the dangerous explosions occur; and coal-dust is more deadly than gas

MIX any powder or dust that is composed of organic matter with the necessary amount of air, and you have a mixture as explosive as that which you use to drive an automobile. Flour explodes and sets fire to mills; threshing-machines burn up because crop-dust has exploded; and coal-mines that are quite free from gas are converted into death-traps because coal-dust has been allowed to form an explosive mixture with air.

Between four and eleven hundred American coal-miners lose their lives each year as the result of coal-dust explosions in mines that are considered safe because they are free from gas. In Belgium, which has the most gaseous mines in the world, not an explosion took place from 1892 up to the outbreak of war.

Causes of Coal-Mine Explosions

As the advertisement has it, "There's a reason." To find the reason, the Bureau of Mines has been making a very elaborate and painstaking series of investigations, as a result of which it has been able to make recommendations that, if followed, ought to make American mines as safe as those of Belgium.

Explosions in coal-mines are caused either by an open light igniting fire-

damp or gas, or by an explosive igniting coal-dust. Without an open flame there would be no explosion. Matches, open lights, explosives which give off flames, mine fires, and arcing electrical machinery are all possible causes of explosions.

Miners Become Callous to Danger

Government engineers who have studied these conditions believe that if safety lamps or permissible electric lamps were used even in so-called non-gaseous mines, more than one third of all the explosions in the country would be prevented. Permissible explosives produce so small a flame and their flash is so brief that if they are used intelligently they will not ignite gas or dust. If dangerous explosives were excluded from the mines, fully one half of the present number of explosions would be prevented.

Even a very small percentage of fire-damp is dangerous, because it will render coal-dust explosive. Without the presence of the gas the coal-dust would not be explosive. The introduction of as little as one and one quarter per cent of natural gas is enough to ignite coal-dust.

Miners become so accustomed to the presence of dust that they overlook it. The fact that the coal-dust is generally scattered throughout the mines makes the danger of an explosion great. Once an explosion is

started, it will sweep wherever coal-dust exists.

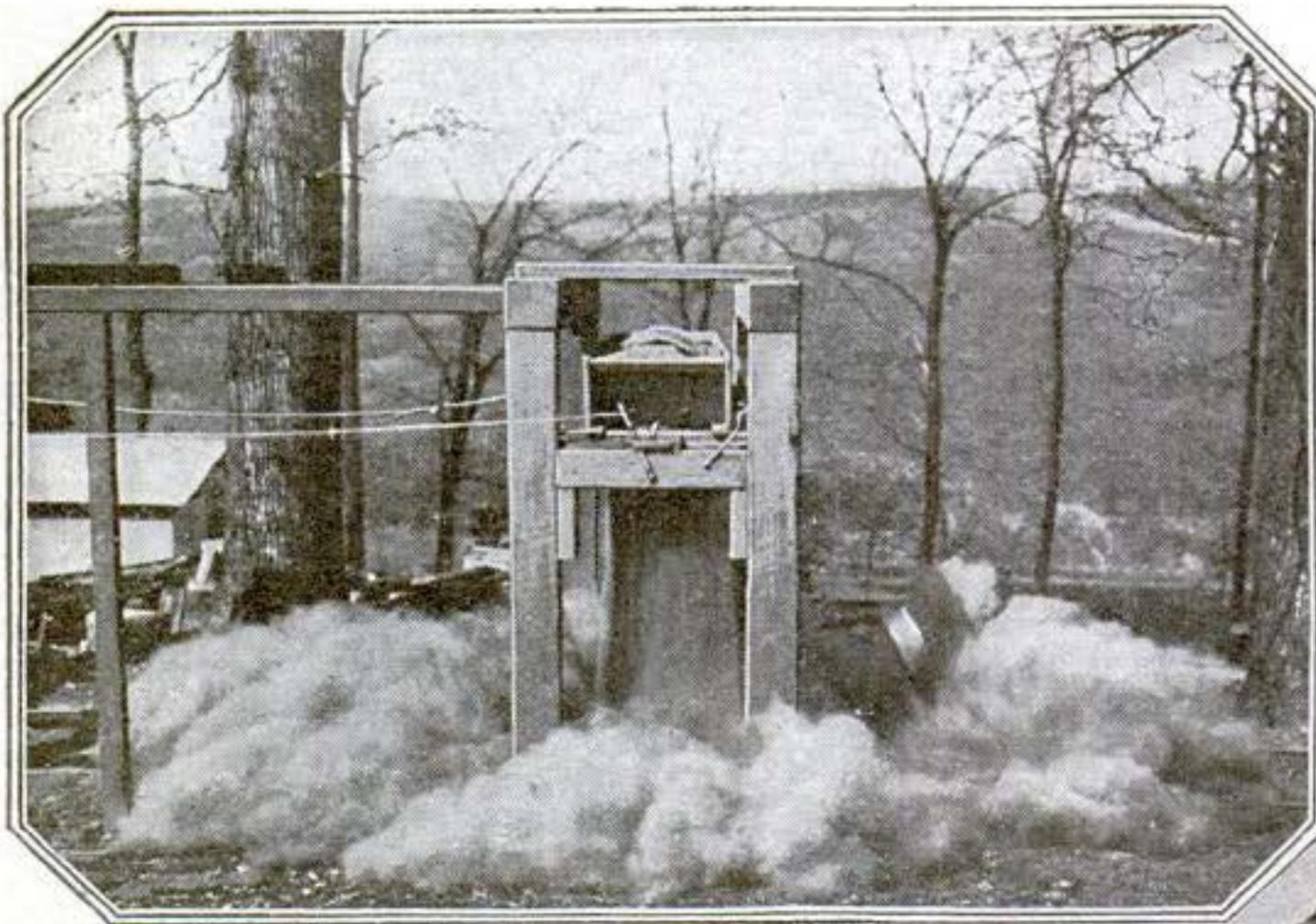
There are two methods by which coal-dust may be treated so as to render the mine safe from dust explosion. One of these is to wet the dust, and the other to cover it with rock-dust or some inert dust. Coal-dust is dangerous only when suspended in the air.

To Stop a Coal-Dust Explosion

As a means of stopping explosions that have started in spite of precautionary measures, a number of "barriers" have been tested.

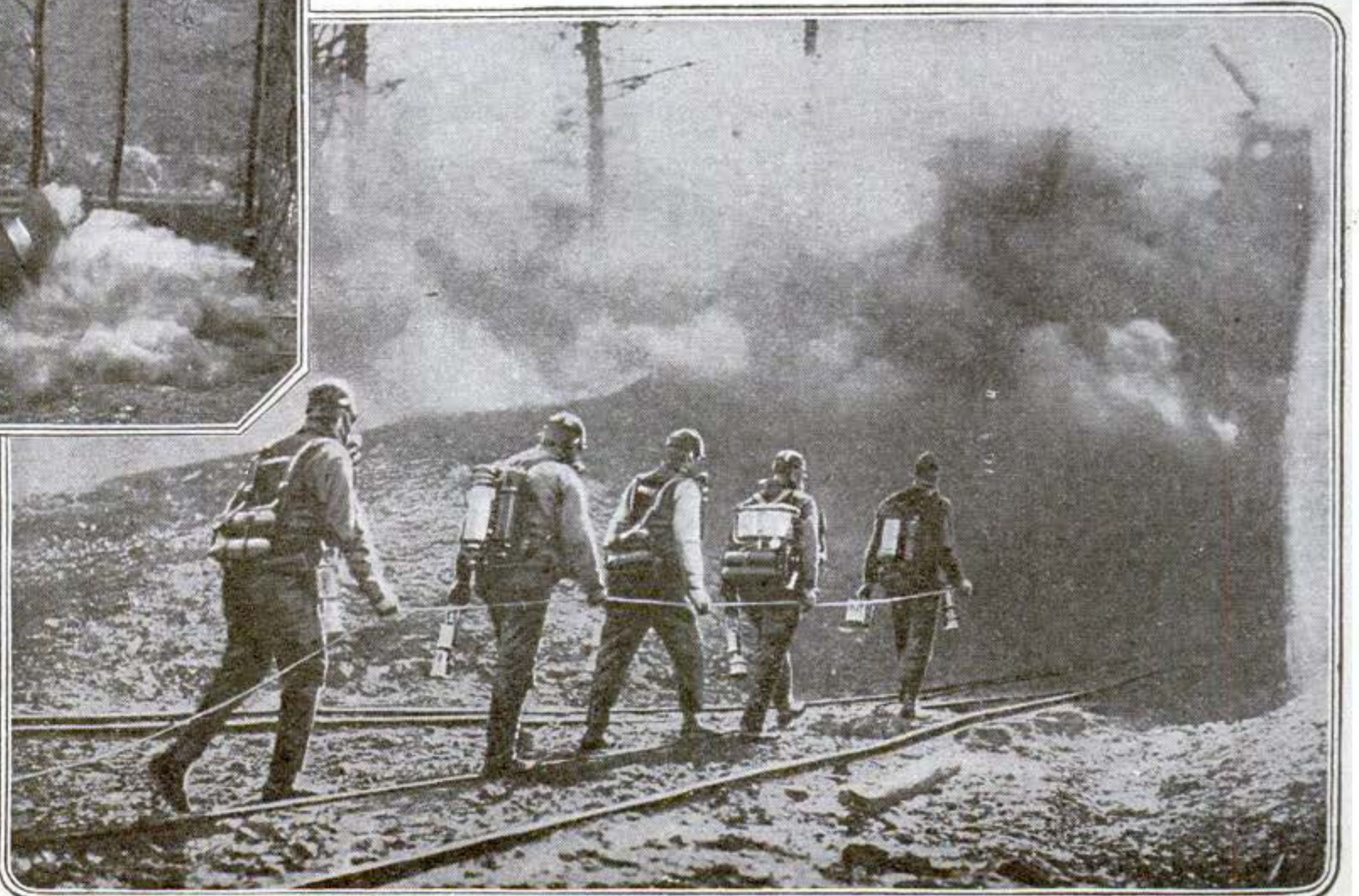
The use of rock-dust barriers originated with J. Taffanel, of the French mine-testing station at Lievin. He found that by blockading the testing gallery with earth he could stop an explosion. This not being practicable, he worked out a method of placing shelves laden with rock-dust across and over the roadway.

The Taffanel shelves were tried in the tests made by the Bureau of Mines, and, while found successful, were not as sensitive as was desired, so six new types of barriers were designed. The principle on which the barriers are operated is to launch non-inflammable rock-dust into the air-blast that precedes a coal-dust explosion. The eddying currents mix the non-inflammable dust with the coal-dust; so, when the flame reaches this dense cloud, the rock-dust, being more plentiful than the coal-dust, absorbs the heat and extinguishes the flame.



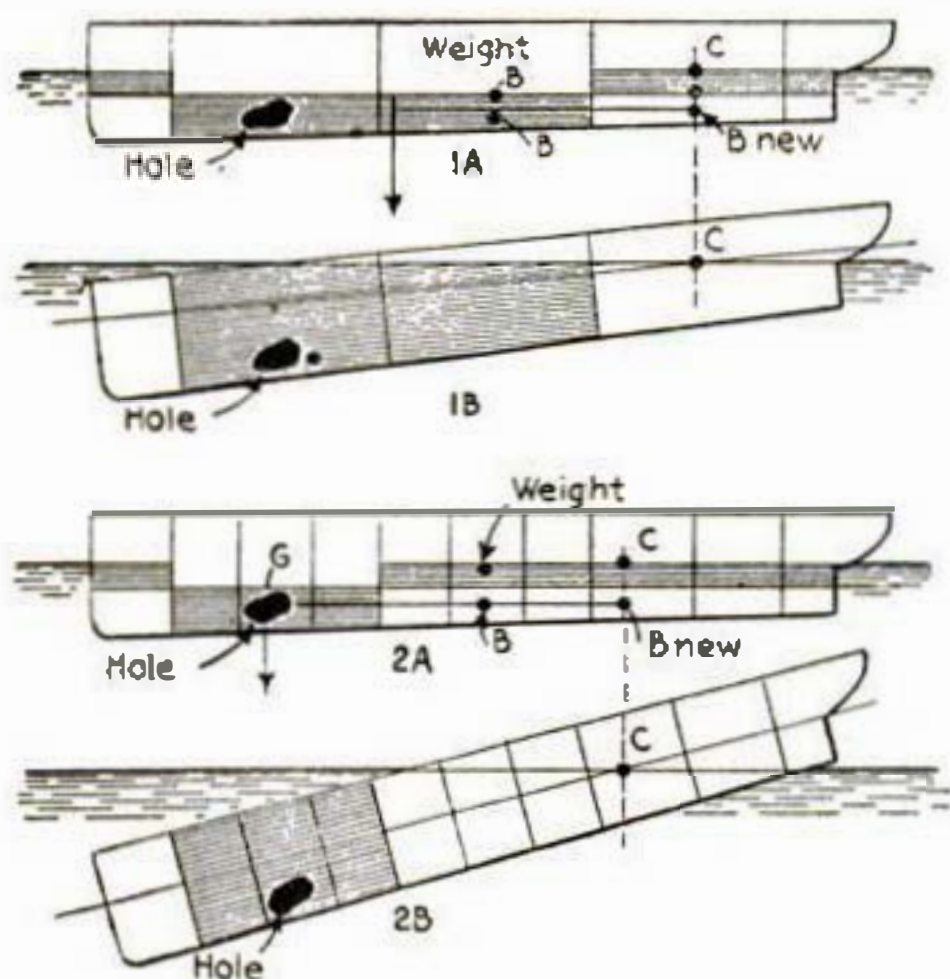
To prevent coal-dust from exploding in a mine, barriers of rock-dust are set up. When the coal-dust explodes the rock-dust is shaken down. This prevents any further propagation of the coal-dust explosion

They are going down to drag men out of the coal-mine. It was not a mine filled with gas. Then why the smoke? The mine was full of coal-dust, which formed an explosive mixture with the air. Then the mixture was ignited by a flame



"She Sank by the Bow"—But Why?

By Joseph Brinker

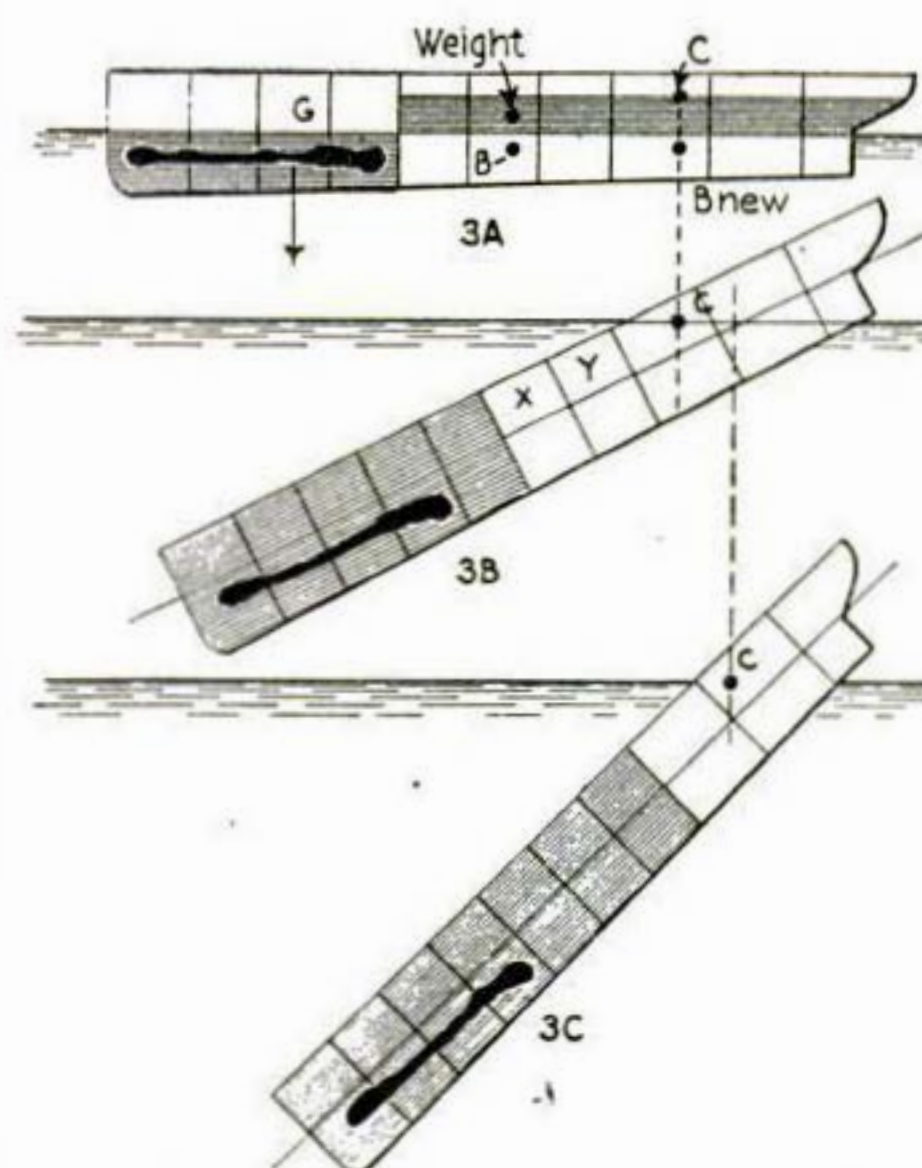


Figures 1A and 1B picture a ship torpedoed between the first and second bulkheads. The water rushes in and makes the third bulkhead from the bow give way, so the second and third compartments are filled with water. The amount of water displaced to the original water-line in the two compartments is indicated by the heavily shaded rectangle.

When these compartments are punctured this displacement is lost, and the boat must sink until the volume of the two lightly shaded rectangles forward and aft of the puncture compartments equal the displacement of the latter. Then the vessel's displacement is again equal in weight to her weight, and she floats. If the two compartments were exactly in the middle of the boat, she would sink equally fore and aft to a water-line level with the top lines of the light rectangles, provided her shape were the same fore and aft of the broken compartments.

Figure 2A shows the same vessel with the space between the second and third bulkheads subdivided by two additional bulkheads. A torpedo hitting in the same spot as in the first case probably would break away only the two additional bulkheads, and confine the water to one half of the space broken away in the first case illustrated. She would sink correspondingly less than in the first case; but the puncture compartments, being nearer the bow, would have a greater leverage about the point C, and make her sink more by the bow, as shown in Figure 2B.

Figure 3A shows the same vessel with a hole ripped in her side clear from the bow. She would then sink under the same principles as in cases 1A and 2A, and go under something as shown in Figure 2B. As the compartments X and Y became submerged, the boat would sink somewhat as shown in Figure 3C.



A SHIP does not float because she has air- or water-tight compartments; nor does she sink because iron or steel is heavier than water; nor does she always remain afloat, if she is wood, because wood is lighter than water. A vessel weighs as much as the water she displaces, and she will continue to float just so long as she does not weigh more than the amount of water she displaces.

Now, the weight of a ship is always the same unless something is put aboard or taken off, because the weight of engines and hull does not change. However, when a compartment is thrown open to the sea by a puncture, the displacement of that compartment is lost, because the water can run in and out at will, and because no water is forced out. The vessel must displace an additional amount of water to make up for the lost displacement of the pierced compartment in order that the weight of the water displaced will equal the constant weight of the ship.

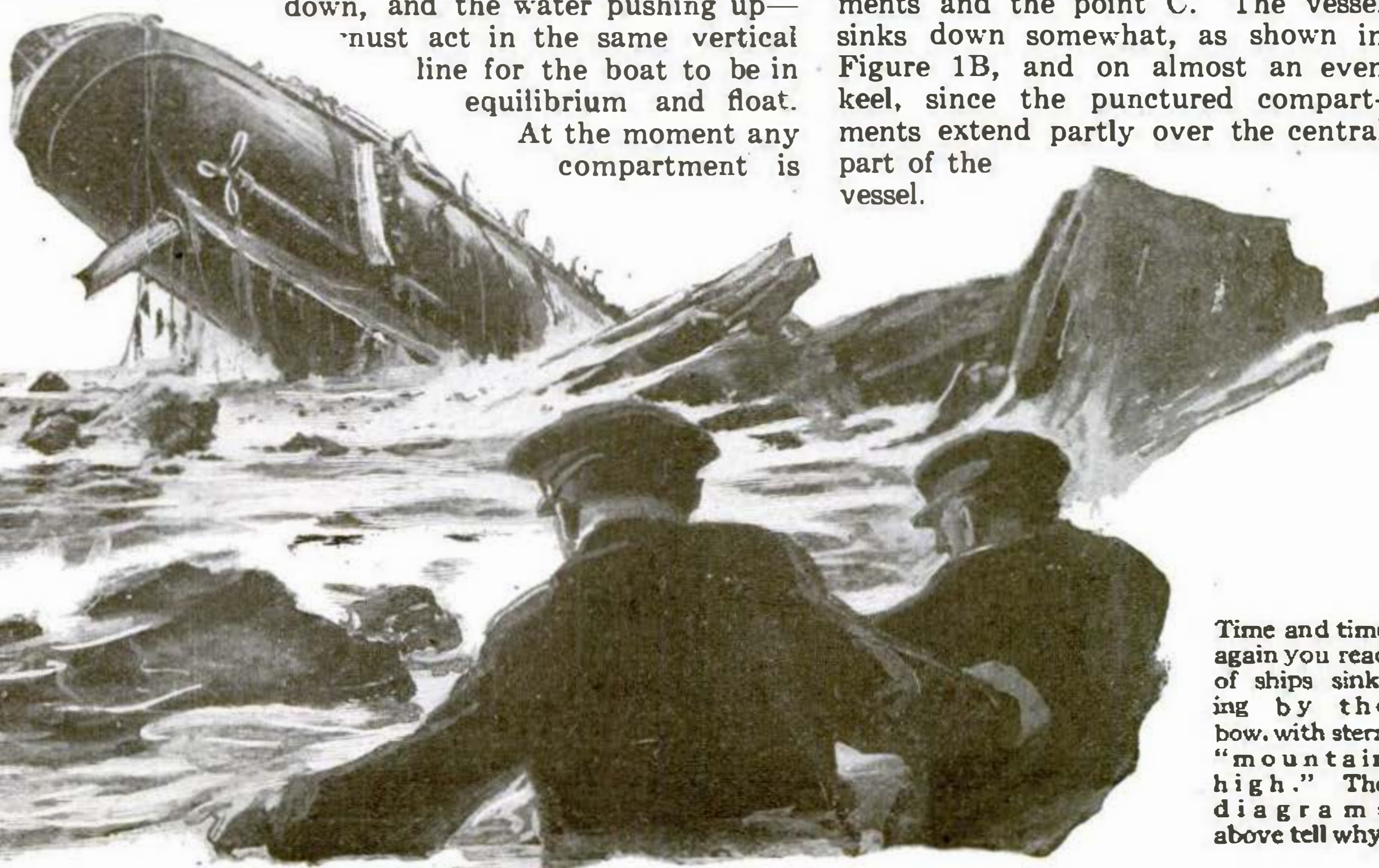
The only way a vessel can do this is to sink deeper in the water until the displacement of the intact parts make up for that lost (Figure 1A).

To understand why the vessel sinks down by the bow, as shown in Figure 1B, it is well to remember that the ship has a center of gravity—that is, a point at which the entire weight could be concentrated to have the same effect as the vessel herself, or a point at which, if you were strong enough, you could balance the entire ship on your little finger without having her tip one way or another.

Now, the weight of the ship acts down through the center of gravity, while the center of buoyancy of the displaced water, or the point at which the upward push of the water might be concentrated, acts up and against the weight acting down. These two forces—the weight of the vessel pushing down, and the water pushing up—must act in the same vertical line for the boat to be in equilibrium and float.

At the moment any compartment is

pierced, the water around and underneath that compartment ceases to push up, since it is free to run in and out, and the center of buoyancy is at once changed to the center of gravity of the water displaced by the intact portion of the vessel. In Figure 1A this point is approximately at *B new*, and the vessel tends to sink about the point C, which is directly above *B new* and the center of gravity of the intact waterplane. The weight of water in the lost displacement in the two punctured compartments then tends to pull the vessel down about the point C in much the same manner as an equal weight would tend to pull down the free end of a stick pivoted at the point C and equal in length to the distance between the center of gravity of the water in the compartments and the point C. The vessel sinks down somewhat, as shown in Figure 1B, and on almost an even keel, since the punctured compartments extend partly over the central part of the vessel.



Time and time again you read of ships sinking by the bow, with stern "mountain high." The diagrams above tell why.

Motorist—Is This What

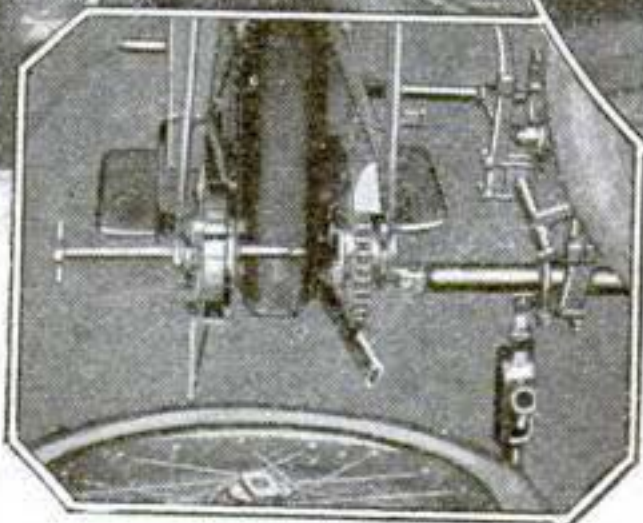
Sixteen Helpful Hints that

In England gasoline is scarce, and even trucks are driven by coal-gas. We have published pictures of coal-gas trucks before, but this is the first we have seen of a truck with a dumping body

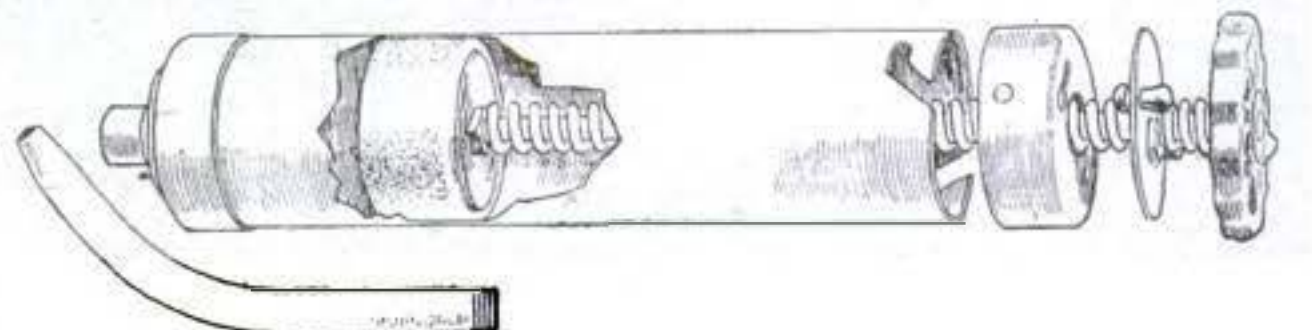


This gasoline measure has a tubular spout at the bottom that facilitates the filling of motorcycle reservoirs

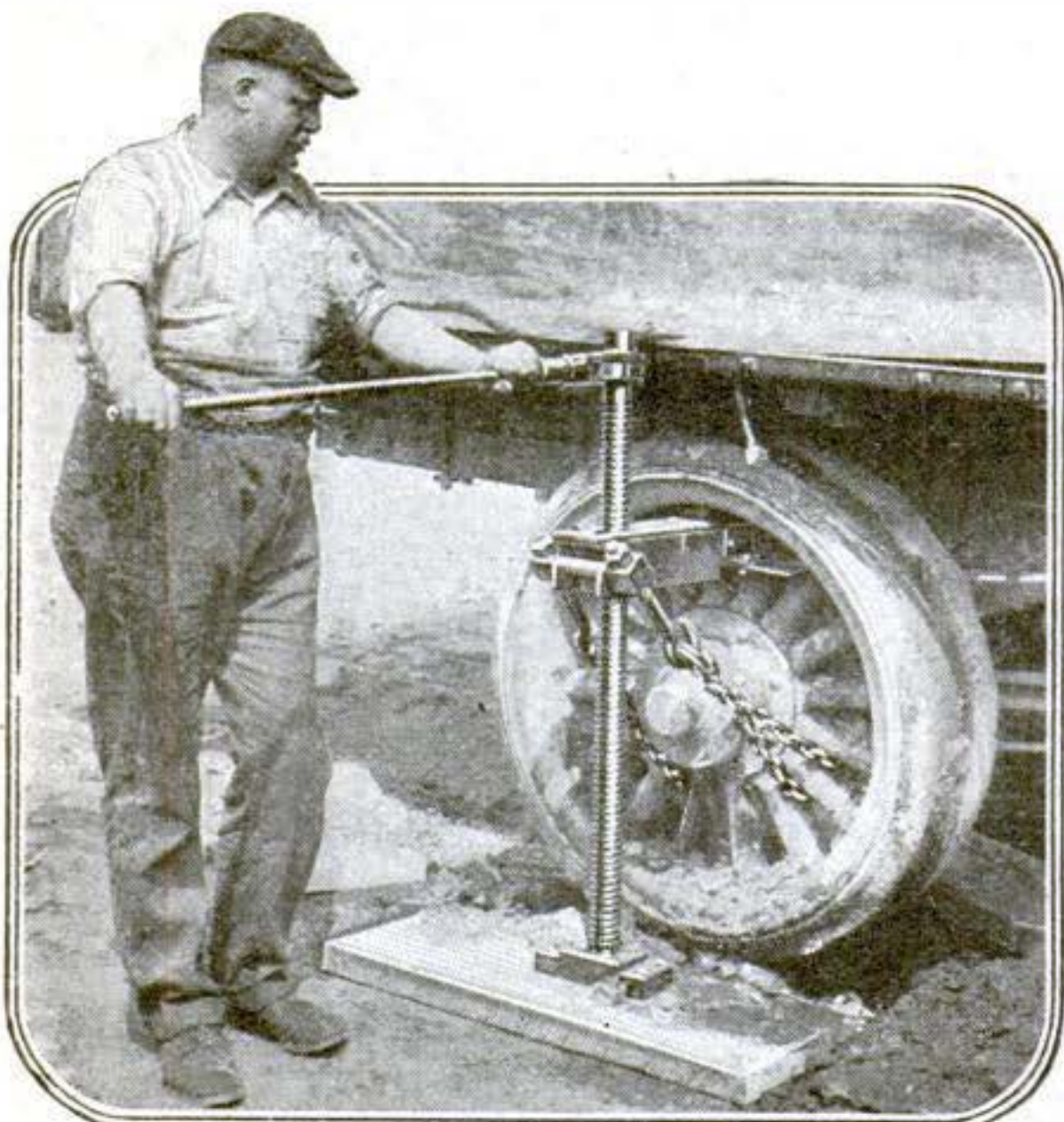
Motorcycles used by the American army are equipped with a device for removing any damaged wheel by merely unscrewing a pin. Detail is shown plainly in the smaller picture



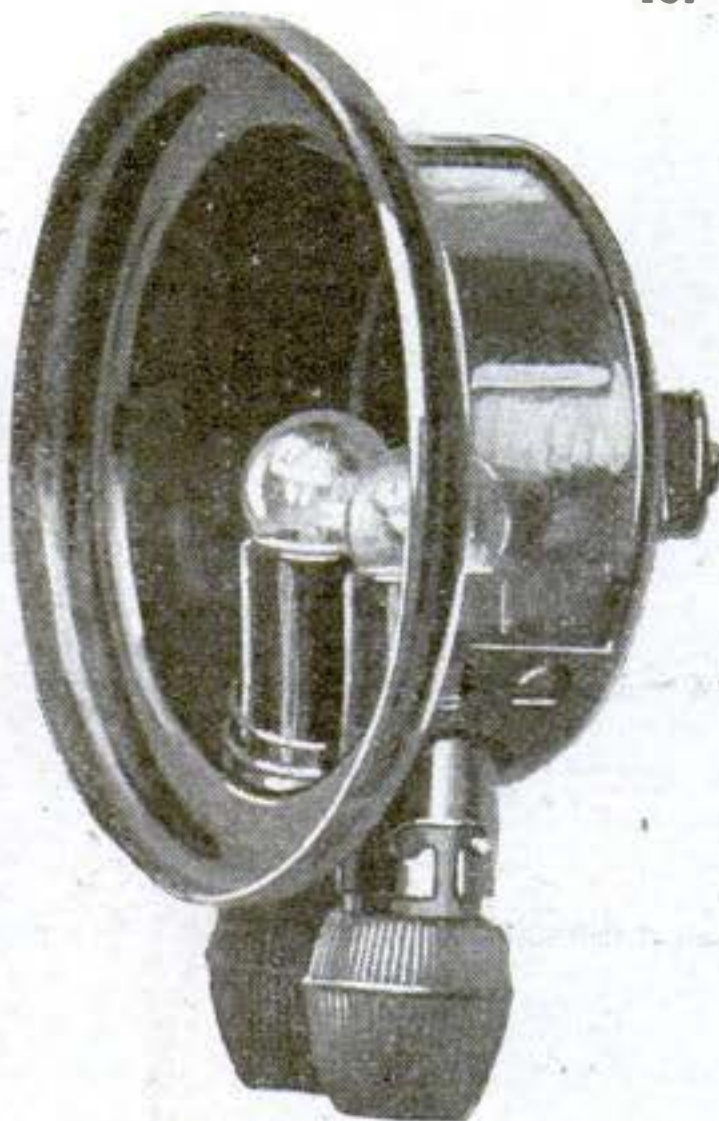
A manufacturer of automobile tops in Los Angeles has devised this sign to attract attention to his place of business



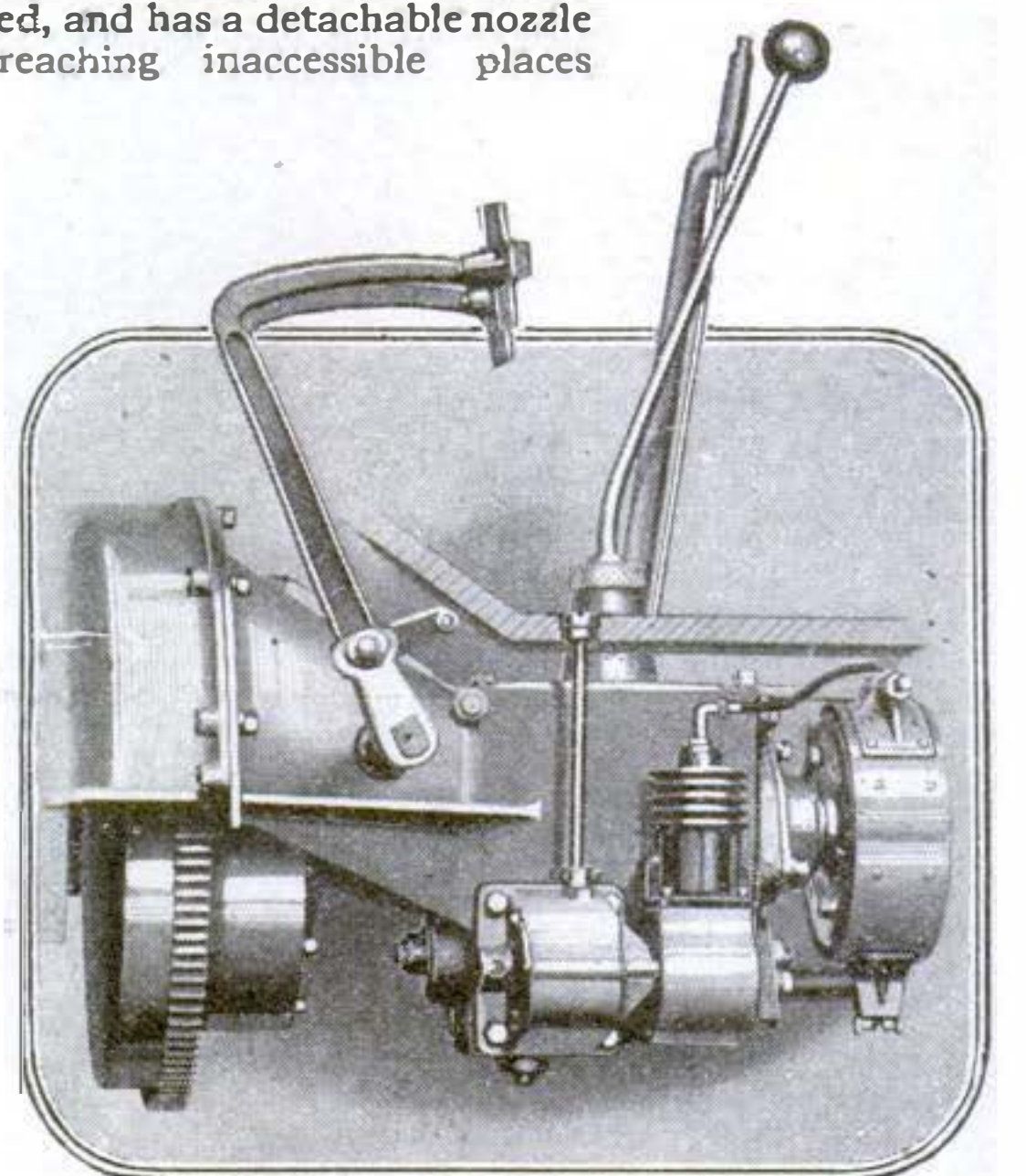
A simple grease-gun that is easily cleaned, and has a detachable nozzle for reaching inaccessible places



This new screw-jack, intended for heavy trucks, engages the wheel inside the felloe at the top with its lifting outrigger. Chains keep the wheel from sliding off



A new tail-lamp for Fords has two incandescent bulbs. One receives its power from the fly-wheel magneto, the other is operated by two dry cells



This ingenious tire-pump for giant motor-trucks is driven from the gear-set or transmission housing

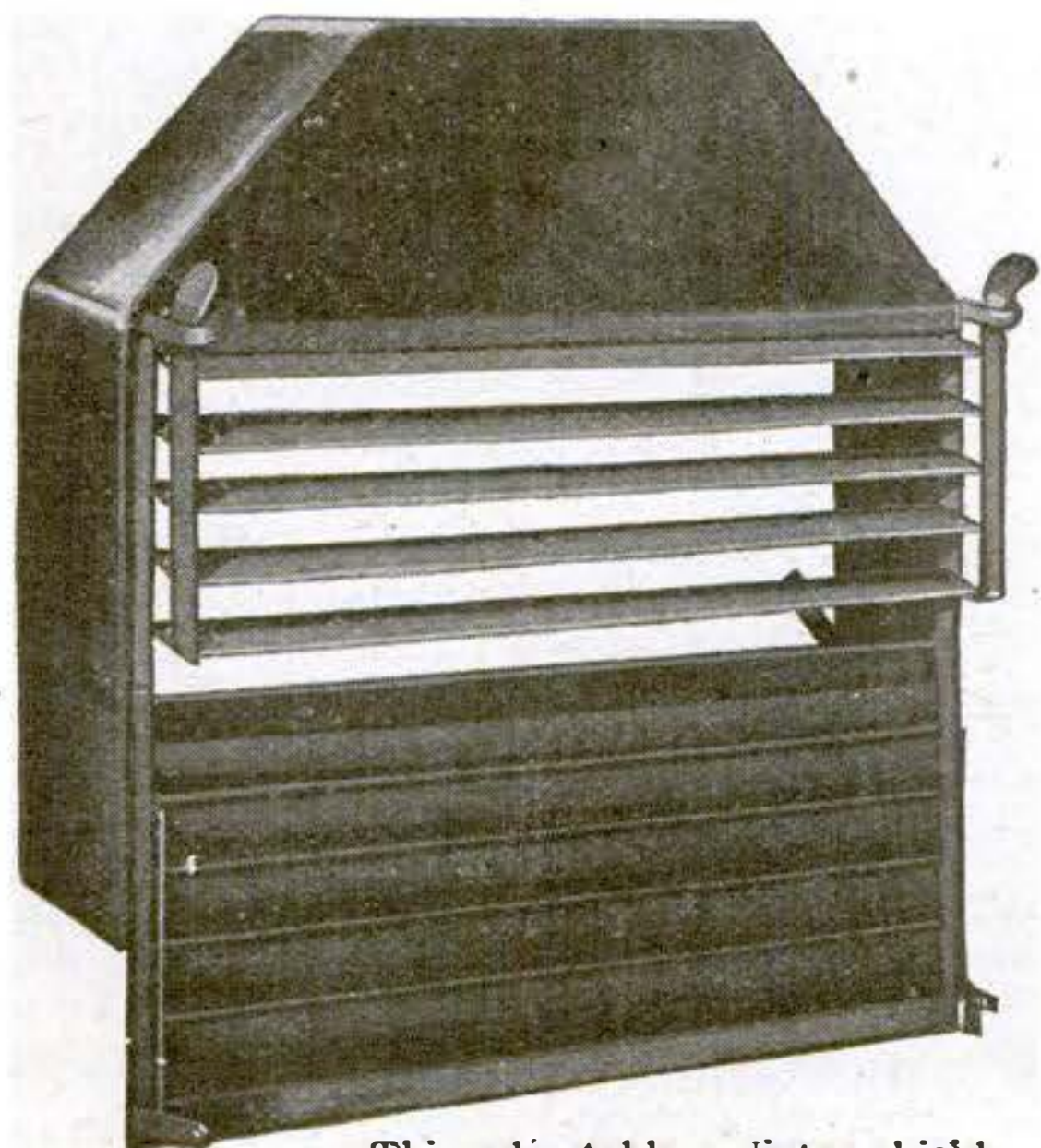
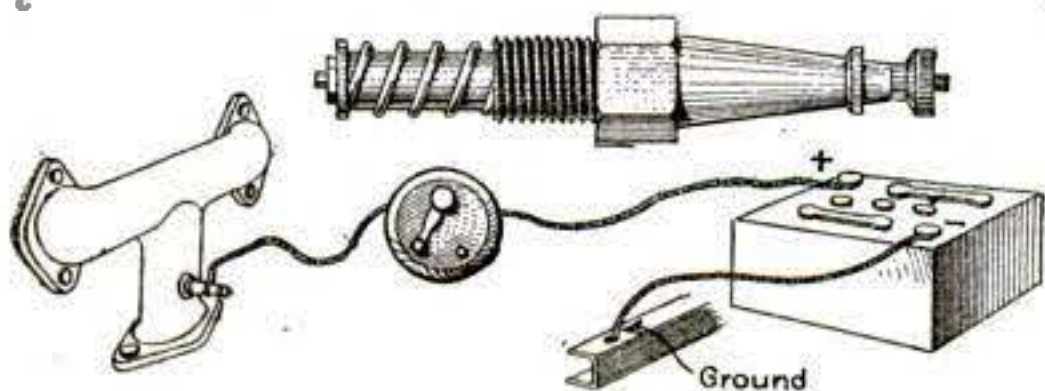
You Are Looking For?

Mean Greater Ease and Comfort

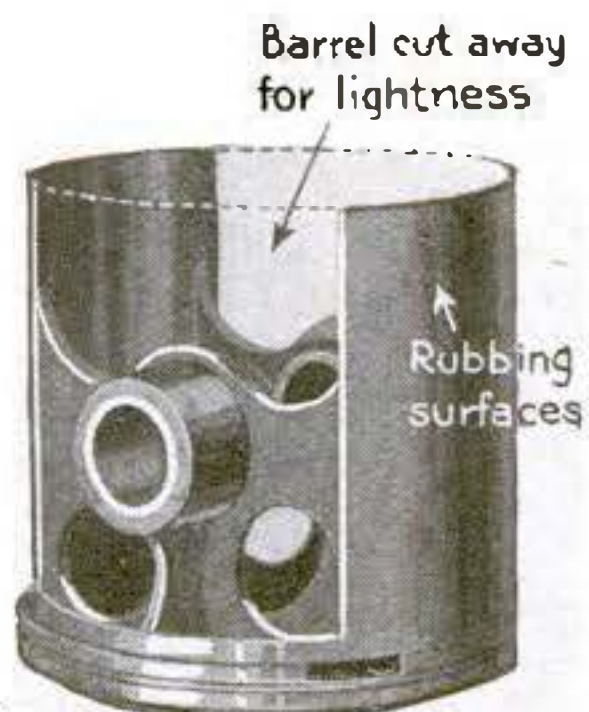
Below: Washing the automobile with the spray-brush shown here is almost a pleasure. The spray nozzle is in the center of the brush, and the flow of water is controlled from the handle



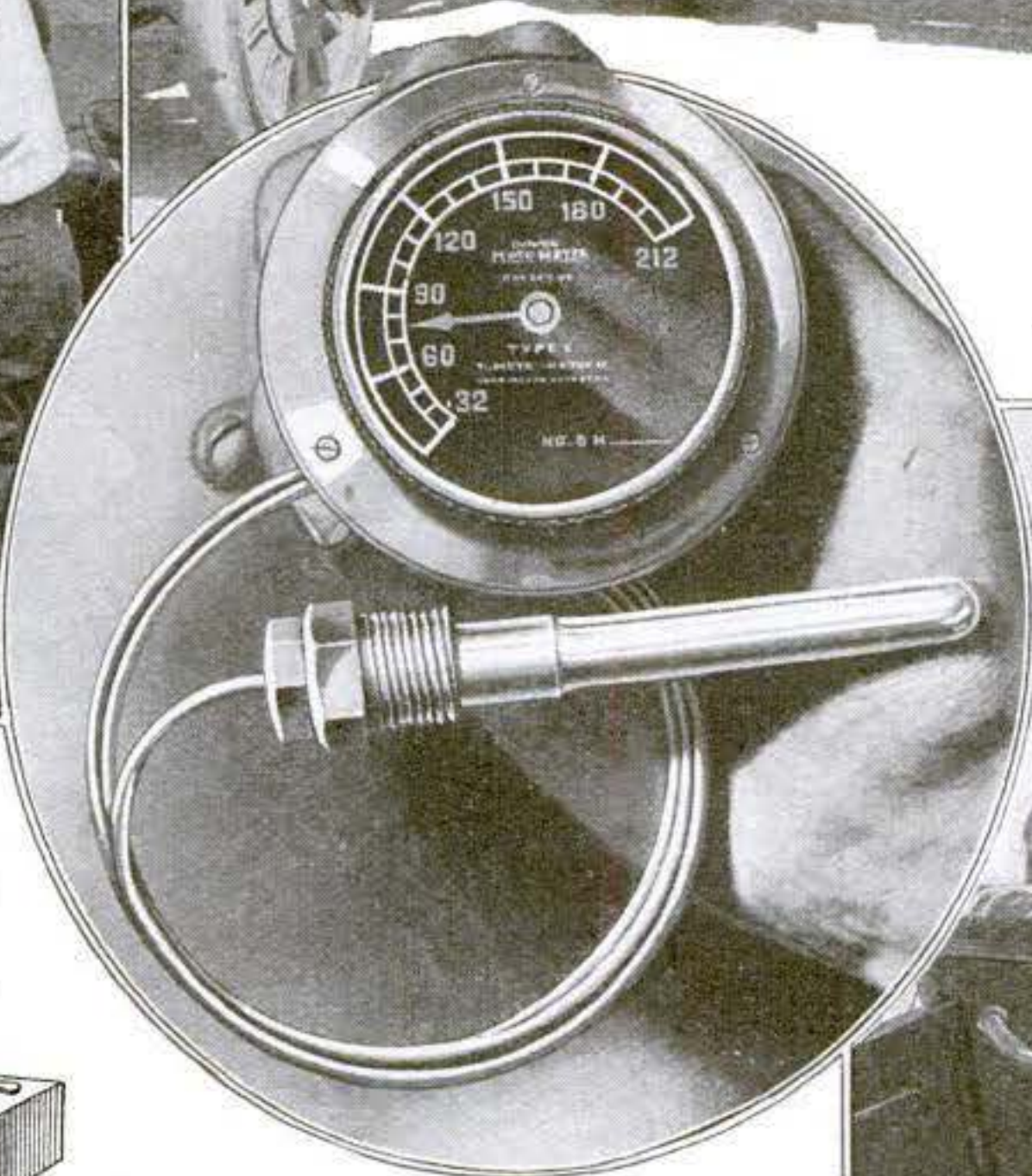
A plug operated by storage battery heats gas in the intake manifold, insuring quick starting in cold weather.



This adjustable radiator shield can be fitted to any automobile

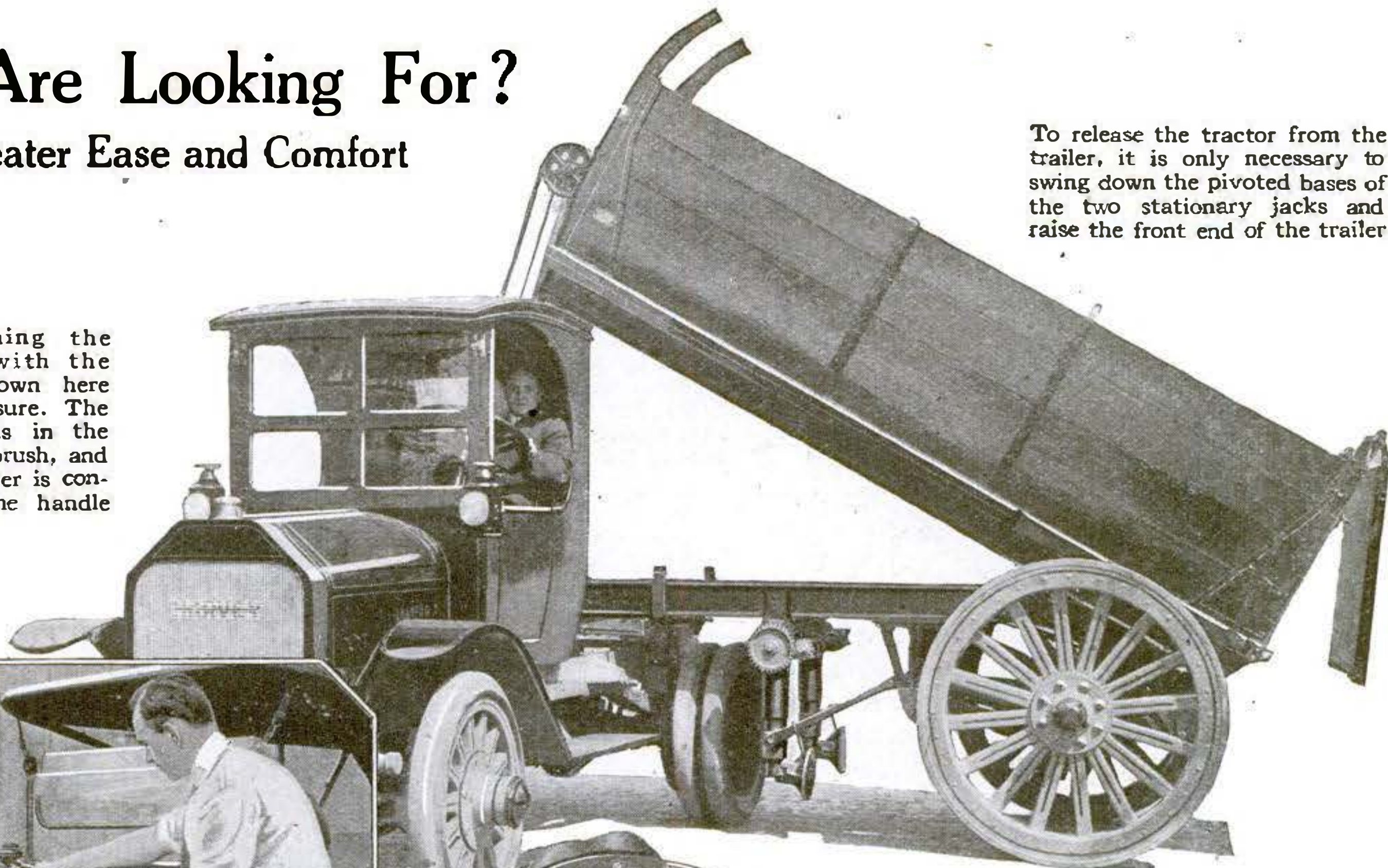


A piston which is lighter than ordinary pistons, and the use of which means a saving of gasoline

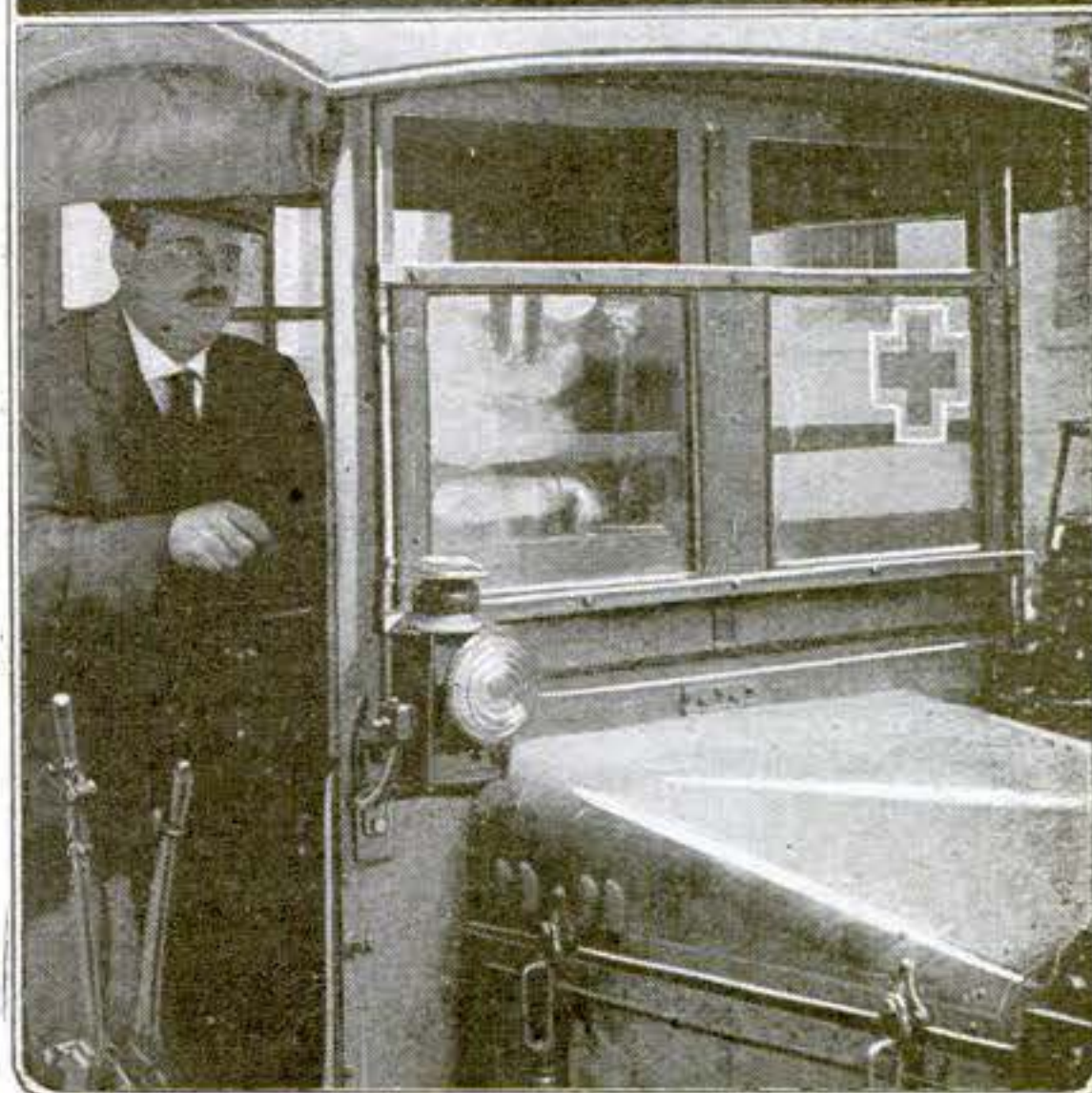


The expansion of alcohol in the pressure-bulb according to the temperature of the water in the engine operates the pointer on the dial attached to the dashboard

To release the tractor from the trailer, it is only necessary to swing down the pivoted bases of the two stationary jacks and raise the front end of the trailer



This removable holder, which may be slipped over the robe rail, will hold on your hat

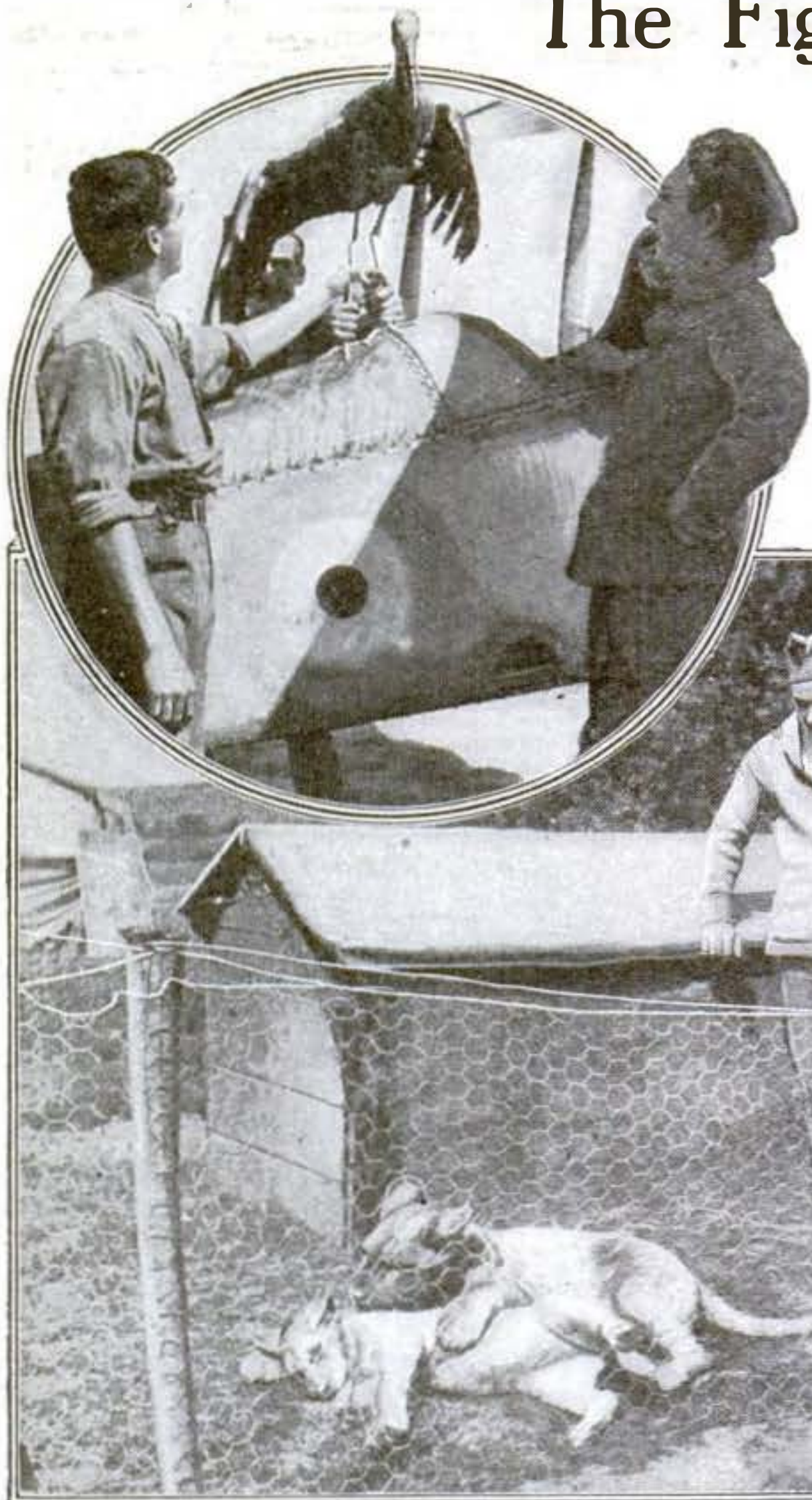


The wind-shield shown here is supported by springs and is especially designed for motor-trucks

The Fighting Aviator's Luck Gods

Anything
from kewpies
to lion cubs

Why the stork, most domestic of birds, was chosen by a fighting air squadron would be hard to say, but these fighters have made the bird more feared than the eagle



The fighting aviator attaches real importance to his mascots, and when they are live ones spends such leisure as he has in caring for them. Raoul Lufbery, the great American ace who was recently killed, was devoted to his two lion cubs, named respectively "Whiskey" and "Soda"



Kewpies are favorite mascots. Many aviators tie one to their machines and inscribe on it records of their flights

This aviator puts his faith in a good-luck cane made out of a splinter from an airplane propeller. Among other things carried are baby shoes, locks of hair, ribbons, dried flowers, ladies' gloves, and rabbits' feet

Turning Night into Day on the Farm

IN those photographs of large Western farms we used to see a few years back, the giant harvesters were drawn by so many large horses that one secretly wondered if the machines, for all their size, could harvest enough grain in a day to give the hungry animals a decent supper.

Easterners accepted that graciously enough; but now comes the rumor, backed by a perfectly good photograph, that farmers have developed their dreams of avarice to such an extent that they sometimes plough at night.

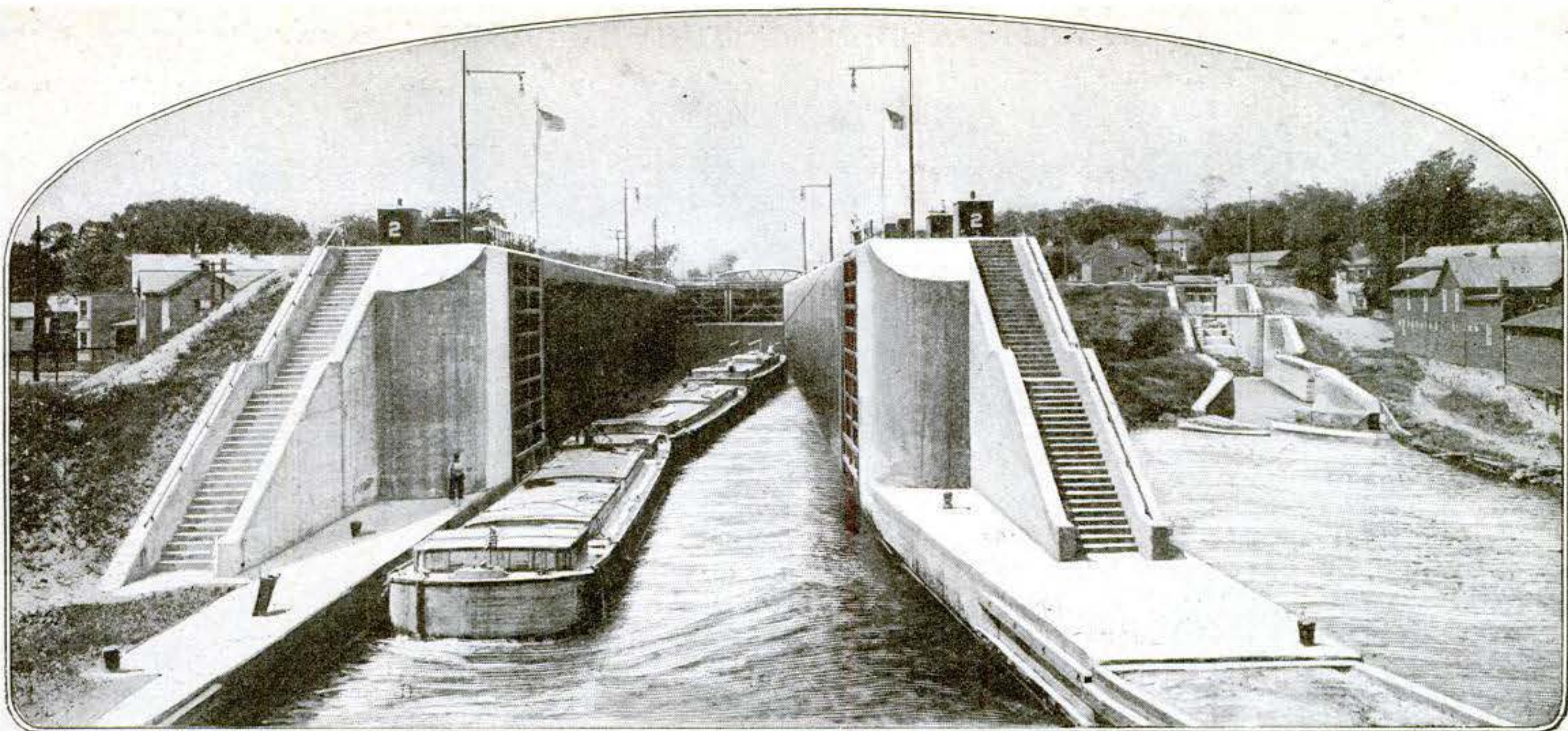
Evidently the hour of daylight generously donated by the Government was not enough. They must go and rig up a powerful electric searchlight on their ploughs, so that now a motor-driven plough can earn its place in the moon as well as in the sun.

Soldiers say that the most shocking sight in their experience is that of a tank, gushing flames and smoke, waddling across No Man's Land.



Think of the shock that must be delivered to the spine of an innocent farmer, driving along a peaceful country road at midnight, who, happening to glance into the nearby field, glimpses a steel thing with spiked wheels and an awful electric eye, gashing the earth's crust and coughing consumptively, merely in order to make potatoes or corn or lima-beans more plentiful for the Allies!

Seriously, though, in time of stress like the present it is gratifying to see that man's mechanical ingenuity seems equal to every test, and that for the purpose of winning the war night can be turned into day in the farmers' efforts to make two blades of grain grow where one grew before. The devotion of the American farmer, with the sacrifice of the rest of the country, promises shortly to end the present world menace.



The Greatest Flight of High-Lift Locks in the World

The lock to the left is the first of a series of five high-lift locks of the New York Barge Canal near Waterford, which form the greatest flight of high-lift locks ever constructed. They lift the boats 169 feet. Each lock is 338 feet long, 45 feet wide, and 12 feet deep. The old locks, on the right, originally completed in 1825

and enlarged in 1862, were each 90 feet long, 15 feet wide, and 4 feet deep. After enlargement they were 110 feet in length, 18 feet in width, and 7 feet in depth. The new lock lifts boats to the same level to which they were formerly lifted by a flight of three locks, which means a very great saving in time

Here Is the Whippet, Latest of Tanks

THE first tanks were officially known as "land ships." They were, in truth, land battleships. Appearing as they did with dramatic suddenness, they were a brilliant success.

The Germans soon discovered that the tanks were slow. So they developed a special method of keeping them off with field artillery.

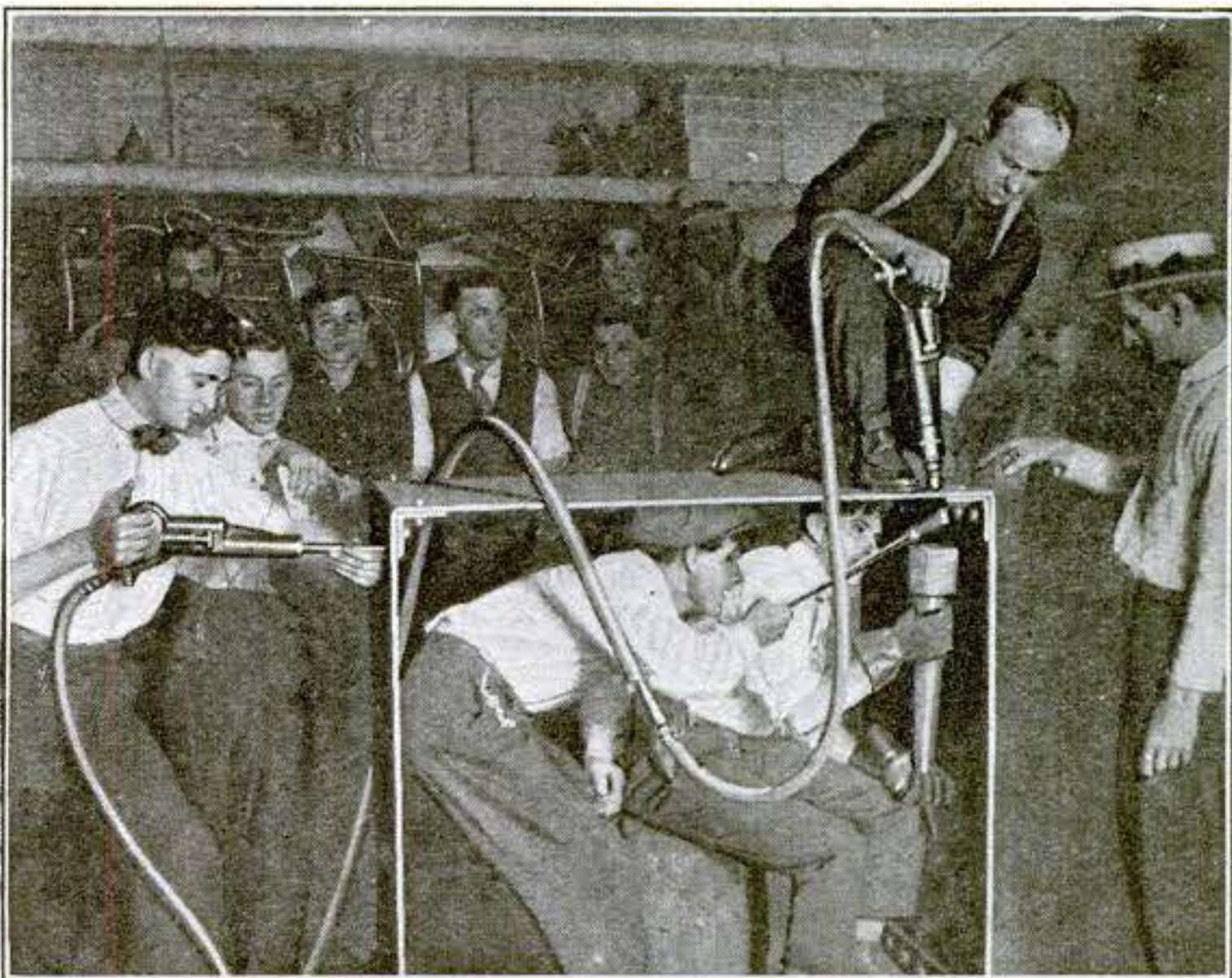
The British were not at all discouraged with this turn of affairs. The tank idea was much too valuable to be abandoned. Mobility was what the tanks needed—mobility and speed.

Now comes the "Whippet," a mere armored housing carried on familiar caterpillar treads. The total length of the Whippet is less than twenty feet.

These new types are able to perform evolutions which were quite impossible for the battleship type of tank.

Raising a New Crop of Shipbuilders

THE necessity of building a large number of ships in the shortest possible time has put a severe strain upon the resources of the United States. Shipyards can easily



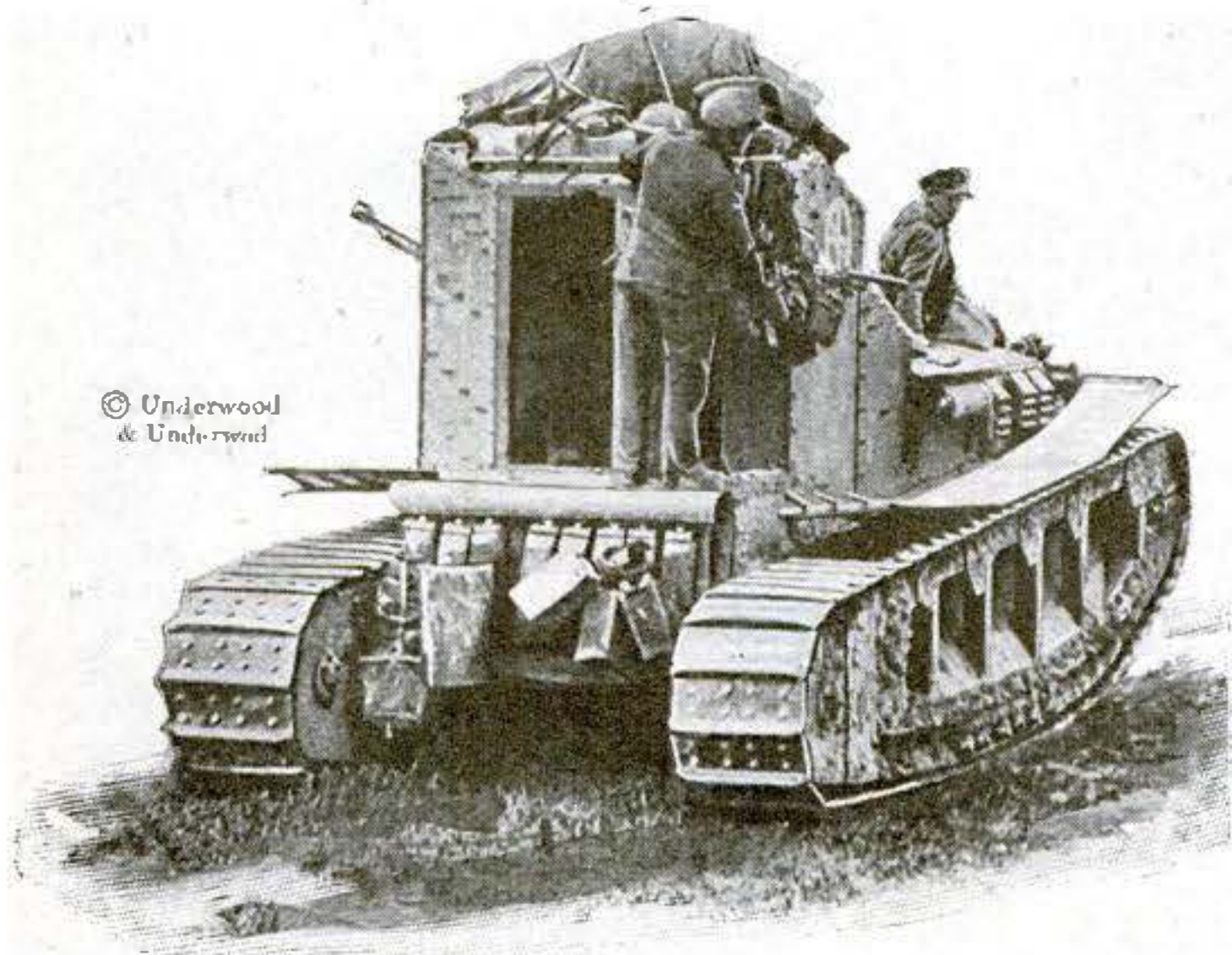
The future of our shipbuilding industry may depend upon the proper training of such young men as these

be built, material may be obtained on short notice; but shipbuilders must be trained.

Several of the large shipbuilding corporations, realizing the need of additional well trained workers, have opened training schools.

The picture shows an evening class of the shipbuilding school at Newburgh, N. Y., receiving practical instruction in riveting and chipping.

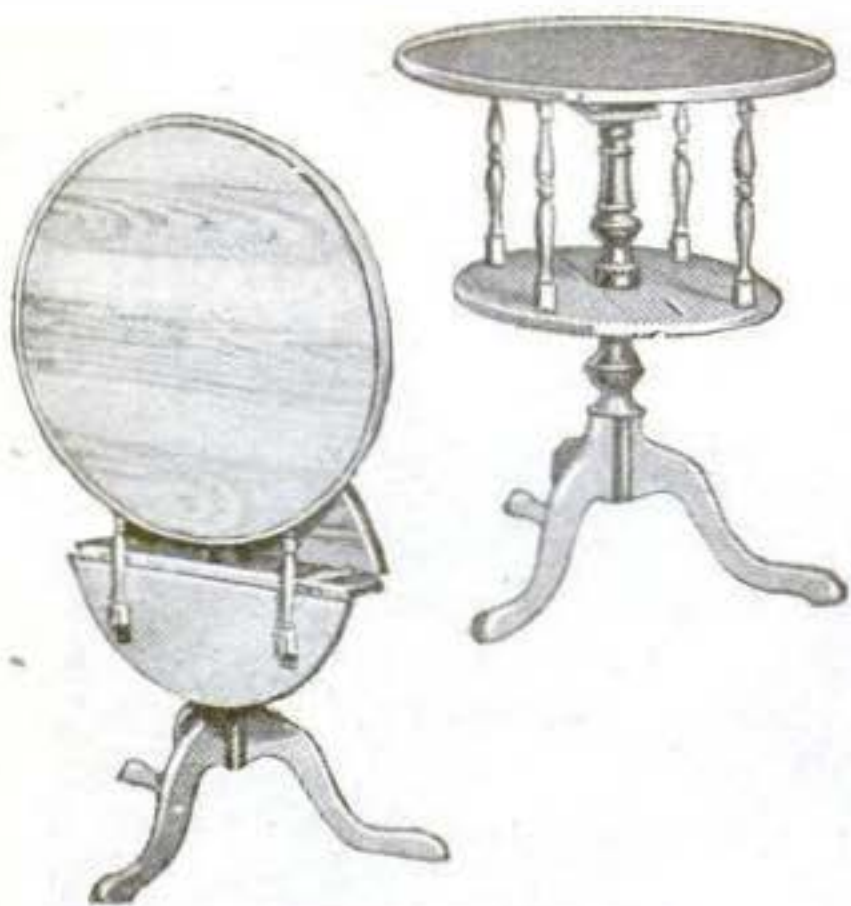
An expert riveter is handling the riveting-machine, while a student is bracing the head of the rivet from inside of the frame. On the other side of the frame a student, guided by an instructor, is learning how to cut off the heads of defective rivets.



© Underwood & Underwood

The Whippet is a new type of tank which is a modification of the old land-ship "tank"

Housekeeping Made Easy



When not needed, this double-deck tilting table can be folded up and put out of the way



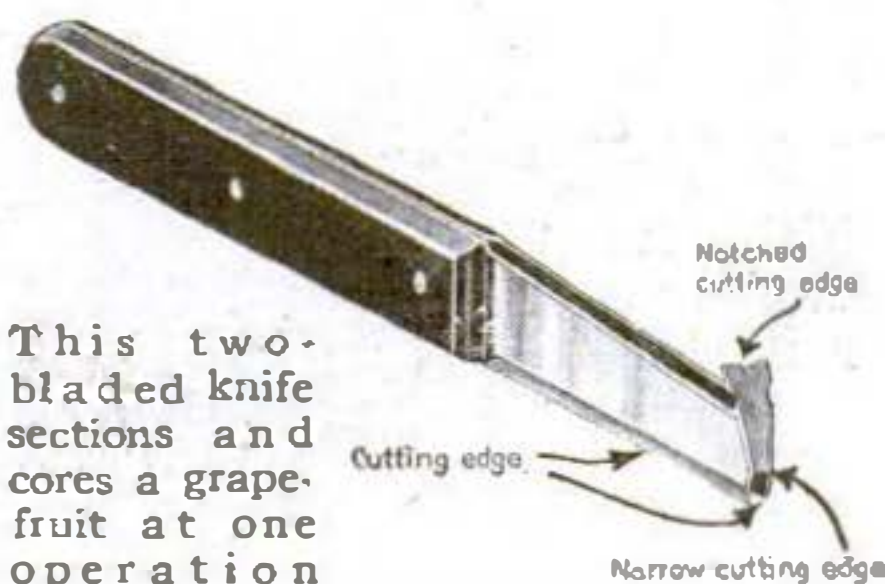
A lamp with an adapter that makes it possible to use with it different shades



Keeping the milk record on a large farm. The records are on a cylinder protected by glass



This baking-dish, or casserole, is handsome enough, in its ornamental plated holder, to appear for service on the dinner-table

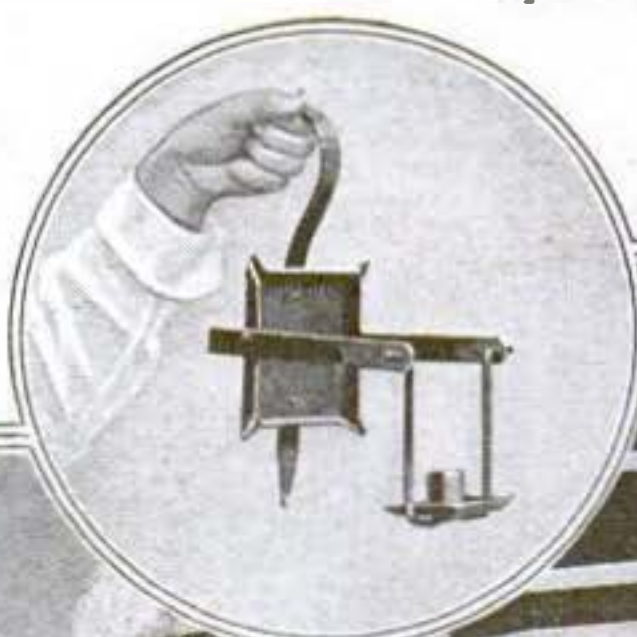


This two-bladed knife sections and cores a grapefruit at one operation



A new method of hanging pictures. A pin with points at both ends is driven into the plaster at a slant, after which the frame is pressed against the pin

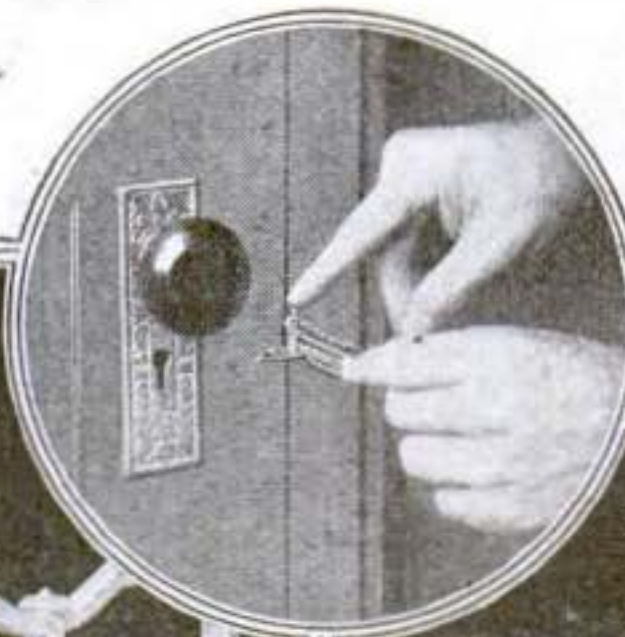
A wrought-iron candlestick that may be used as either a bracket light or a portable candlestick



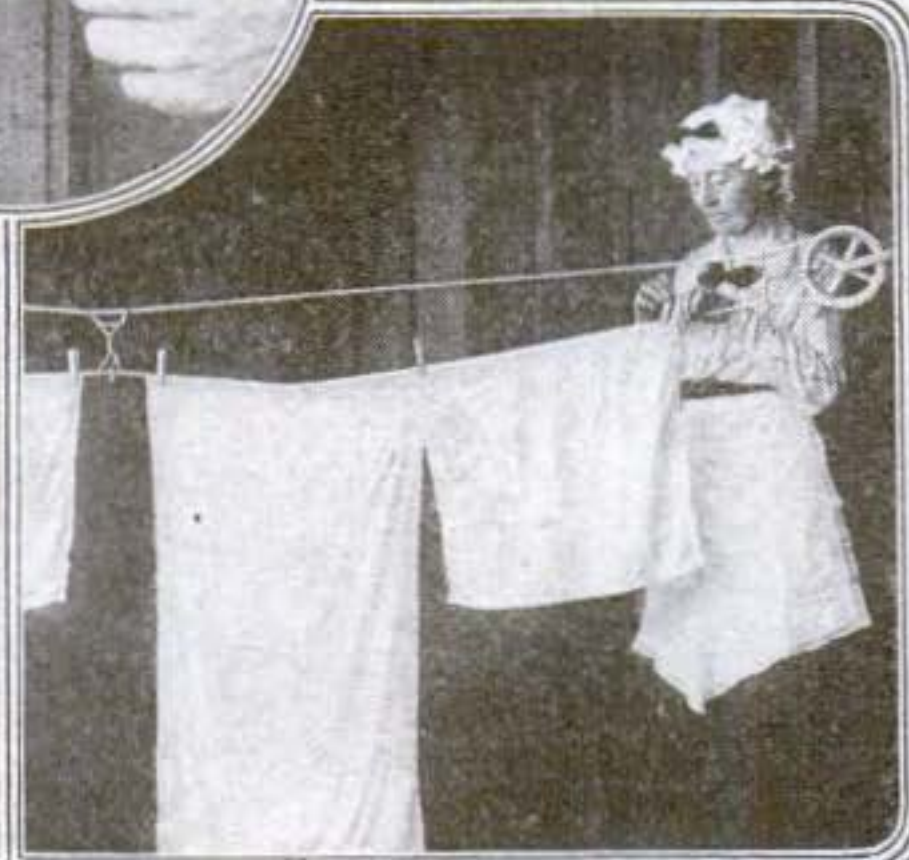
The small ice-carrier shown here is convenient for handling small pieces of ice in the household. It holds the ice by spring pressure



The extra posts in the middle of the head- and of the foot-frame of this double bed make it look like a twin bed and strengthen its frame

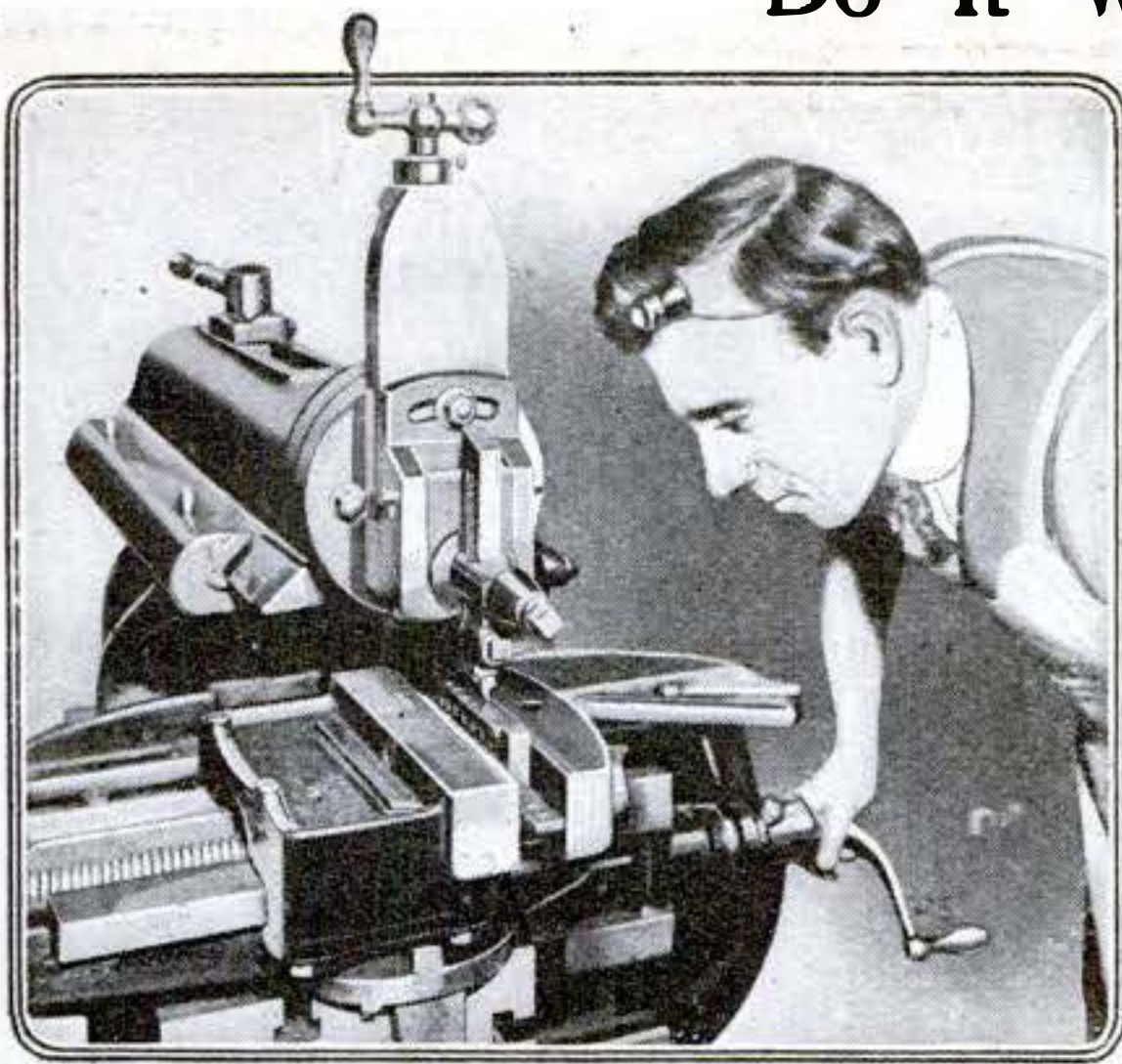


The door-fastener here shown is slipped between door and sash and then fastened by a wedge fitting in a slot of the holding bar



This pulley has a large groove that allows knots to pass over it. The spacer on the left prevents the clothes-line from sagging

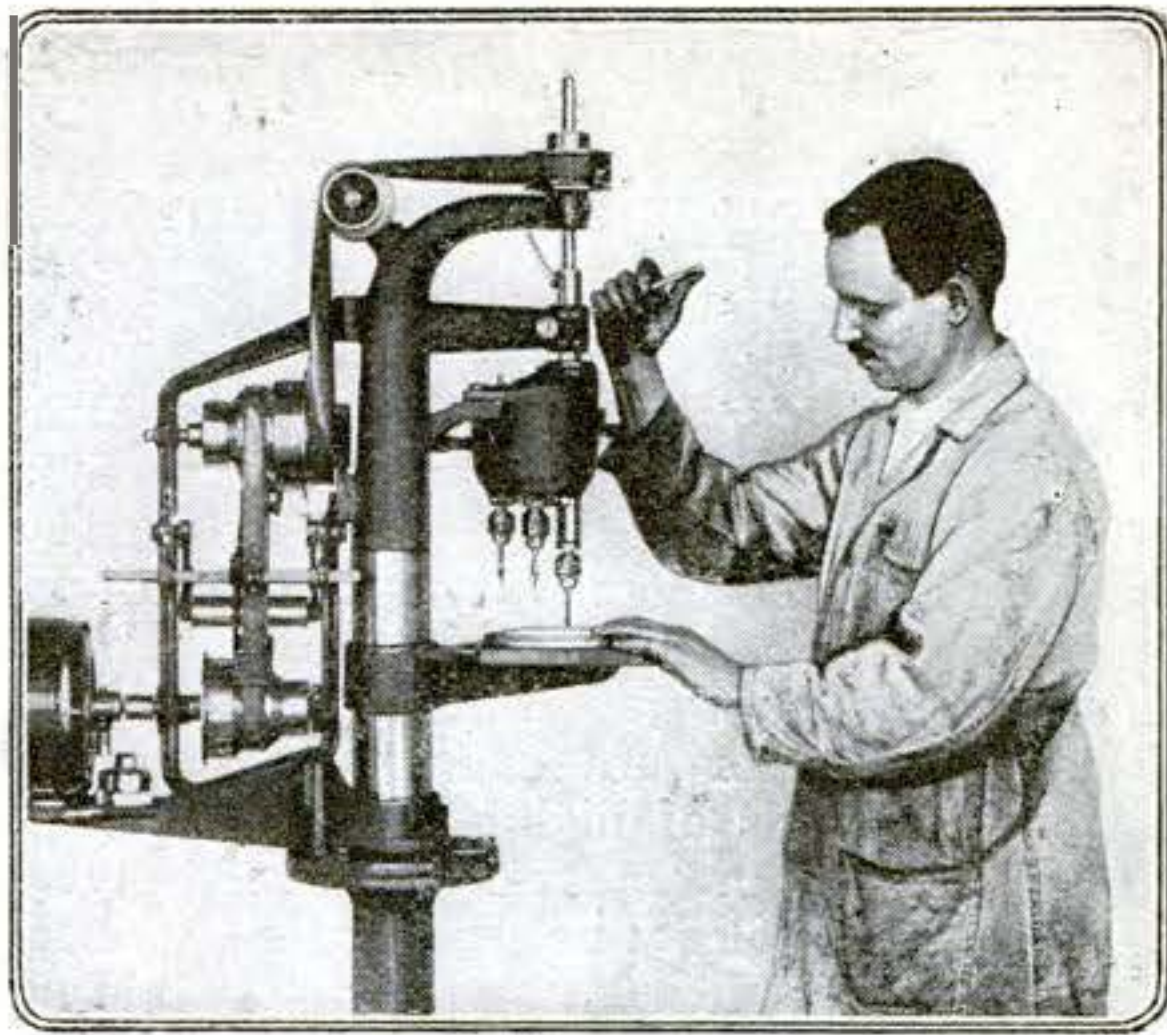
Do It with Tools and Machines



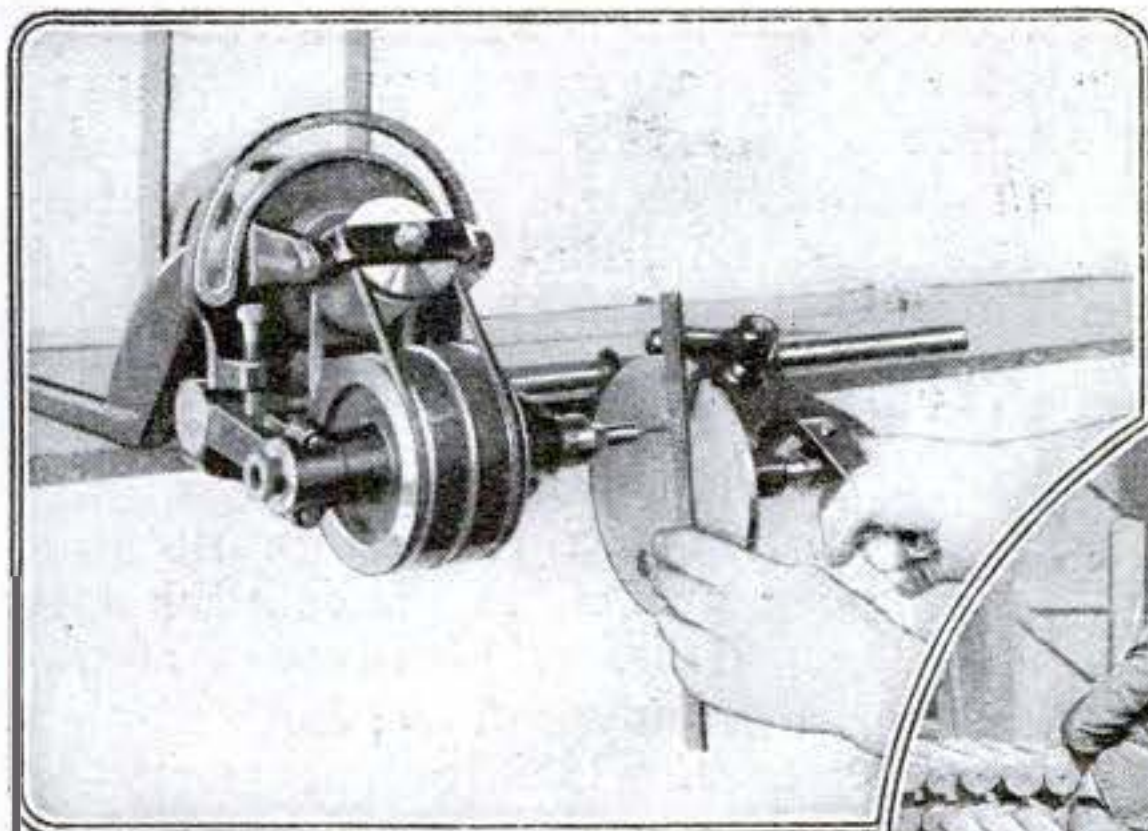
Even the machinist's shaper is now used for making dies to shape false teeth



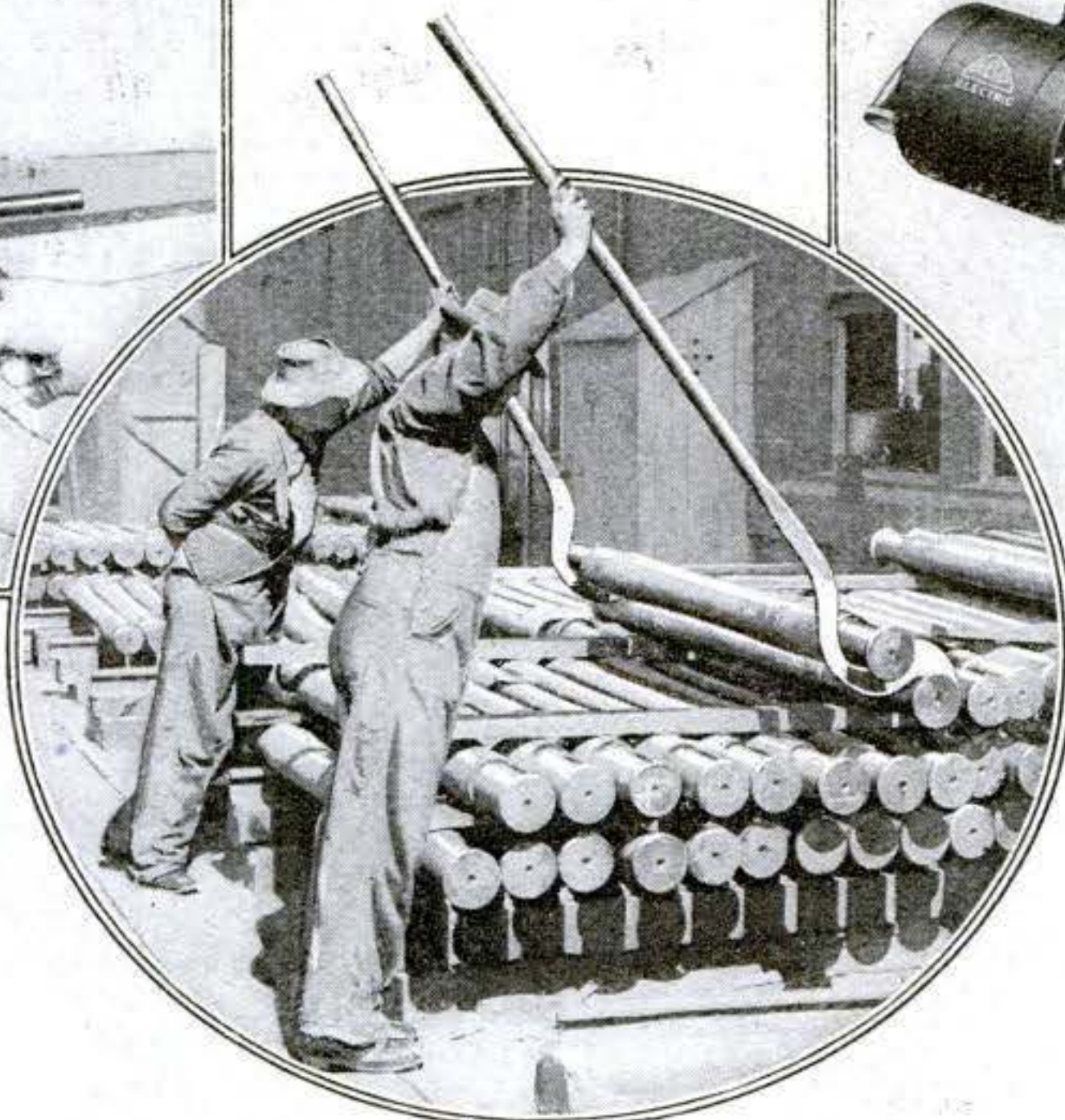
Small sensitive drill-press for the use of manufacturing jewelers



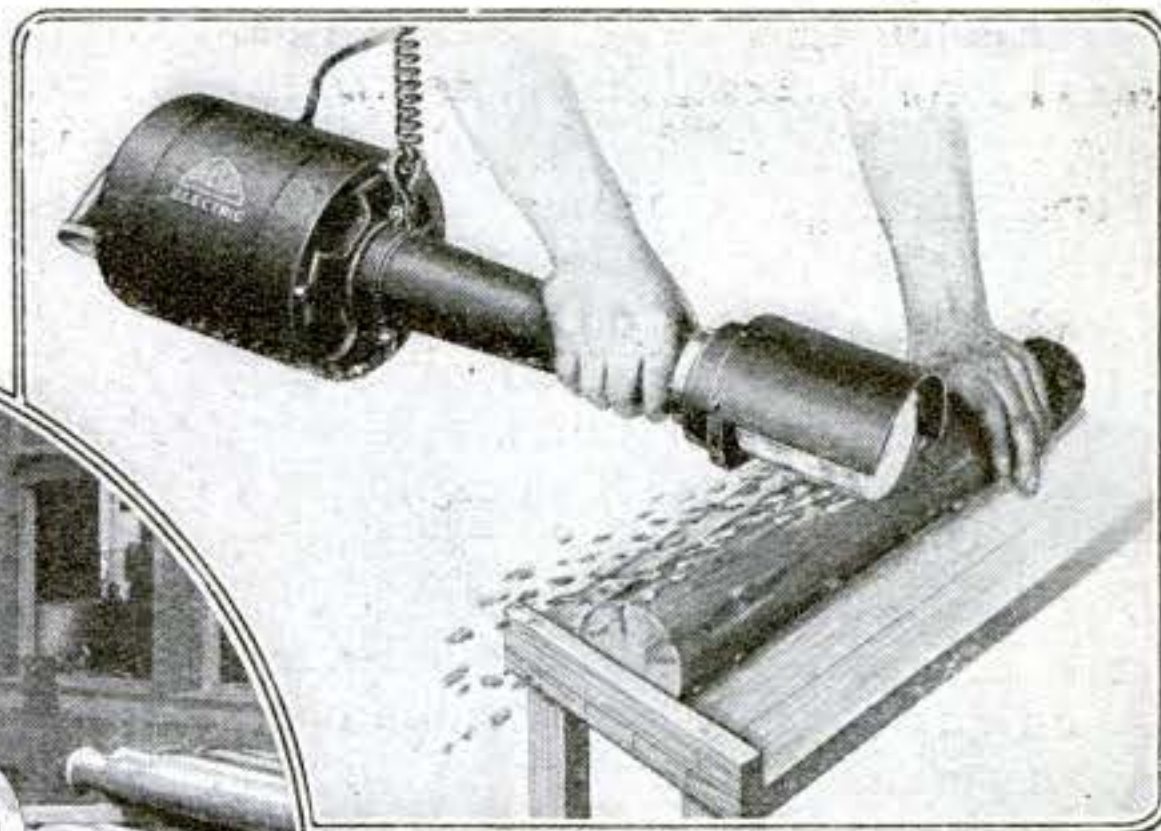
A small drill-press having a multiple spindle carrying four chucks for drilling



With this universal tapping-machine holes may be tapped in work at any angle, because the table can be swung to a horizontal position or any intermediate angle

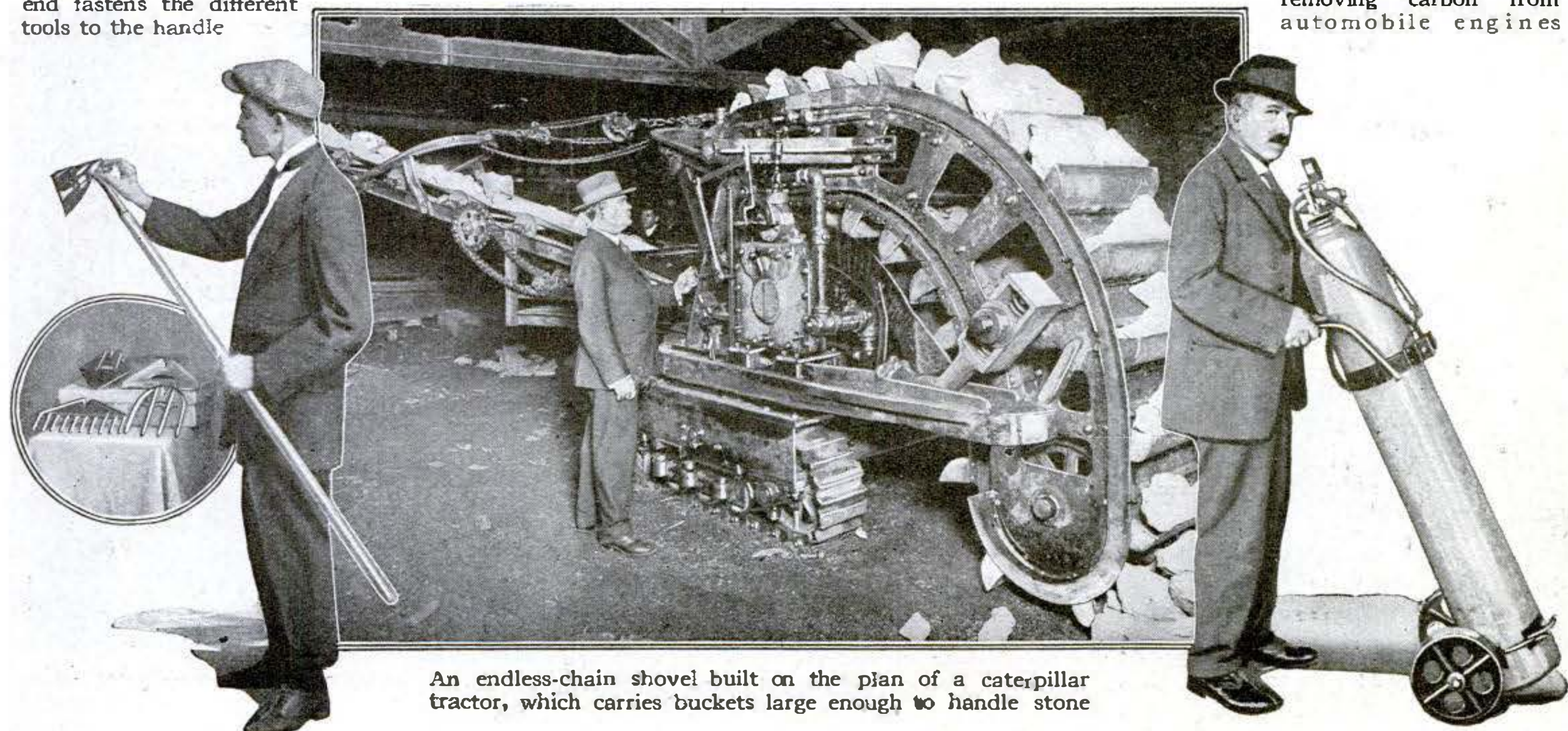


Where there are many axles of this type to be handled, a pair of hooks shaped as shown prevents accidents



A motor-operated barking-machine for removing patches of bark left on the wood after passing through the barking-drum. It covers a broad field in the pulp, paper, and lumber industries

One handle serves for many garden tools. A U-shaped clamp at the end fastens the different tools to the handle



An endless-chain shovel built on the plan of a caterpillar tractor, which carries buckets large enough to handle stone

Attachments for an oxygen-tank for use in a garage and repair shop to make it convenient for removing carbon from automobile engines

Laying a Pipe to Victory

Blasting wire entanglements with the aid of our old friend the cast-iron pipe

By Robert G. Skerrett

DURING their persistent siege of Port Arthur, the Japanese blew up the Russian wire barriers with simplicity and comparative safety, with the aid of long bamboo poles lashed successively together and terminating at their forward ends in ten to twenty pounds of high explosives fastened there in make-shift containers. These poles were pushed forward across ground swept by machine-guns, under the cover of darkness, right into the midst of the wire entanglements. Big gaps were torn in the obstructions and ways were then opened for the assaulting Japanese infantry.

Somewhere on the Western front, not long ago, our engineers resorted to a similar expedient. They connected up long sections of iron pipe, and charged the forward units with considerable quantities of high explosives. Then, as length by length was added, the piping was shoved across No-Man's Land until beneath the Teuton wire entanglements. A portable magneto was cranked, a button was pushed, and a blast followed that cleared a path for our raiding expedition. The Germans were taken by surprise; and none of our troops were jeopardized by being halted to do the usual wire-cutting work.

But every stratagem has its limitations. By this time the Germans have no doubt found an effective foil, possibly in the form of logs or some similar

barrier. Obviously, the American can retaliate, not by persistence in laying their pipes on the ground, but by driving them through it. And this forcing of piping, silently and invisibly, through the earth can be accomplished by using a very effective American tool called a pipe-forcing jack.

The jack is nothing but an iron cage which travels on a steel rack with the aid of teeth. Turn a handle and the cage moves forward. At the front of the cage is a groove, and a clamp that can be adjusted to hold pipe ranging from three quarters of an inch to four inches in diameter. The rack is provided with foundation plates and bolts for securing it to a plank; it also has guides for holding the pipe in line. The cage travels a distance of seven and a half feet; hence, the jack is designed to handle unit sections of seven feet four inches in length.

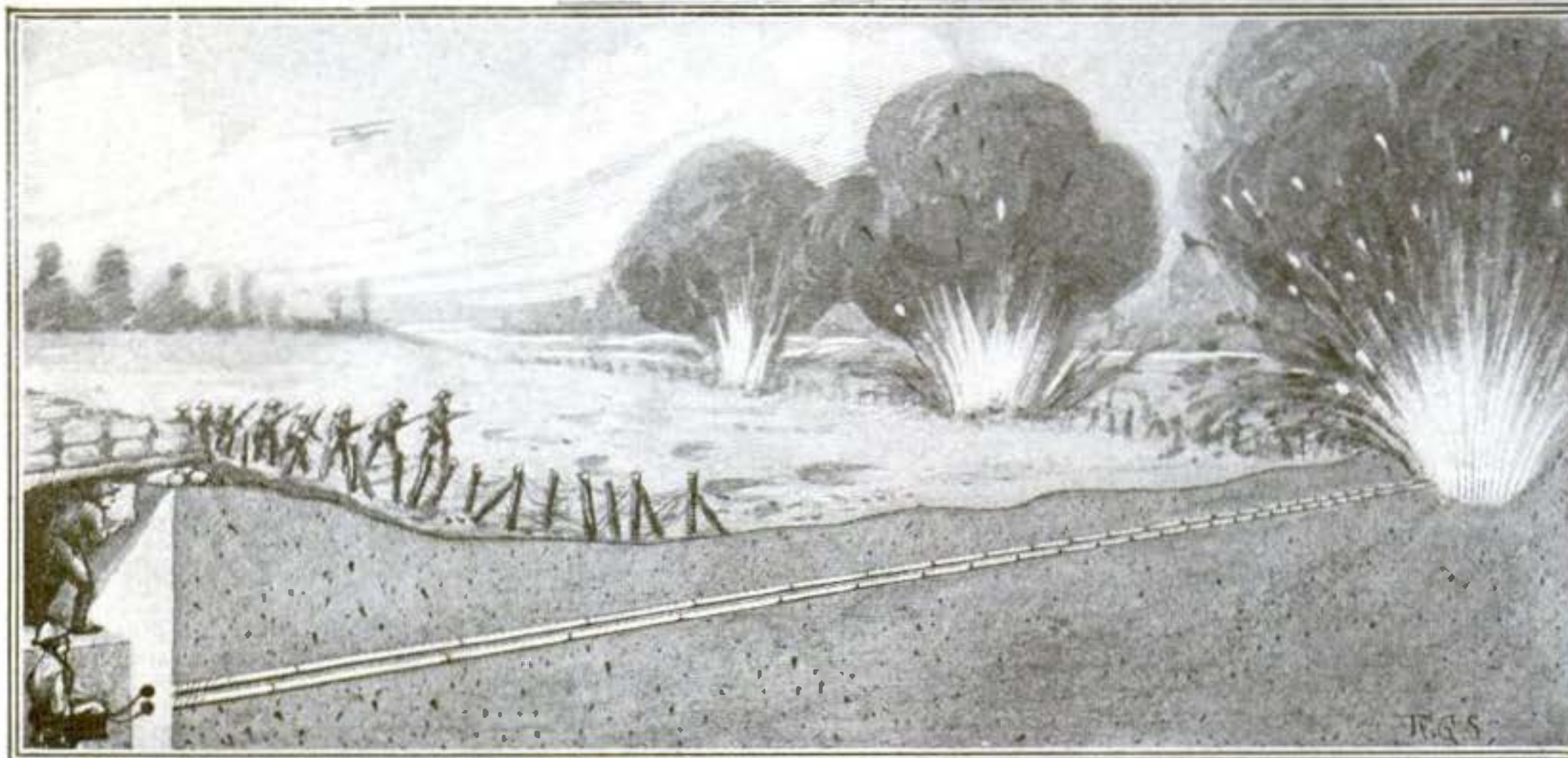
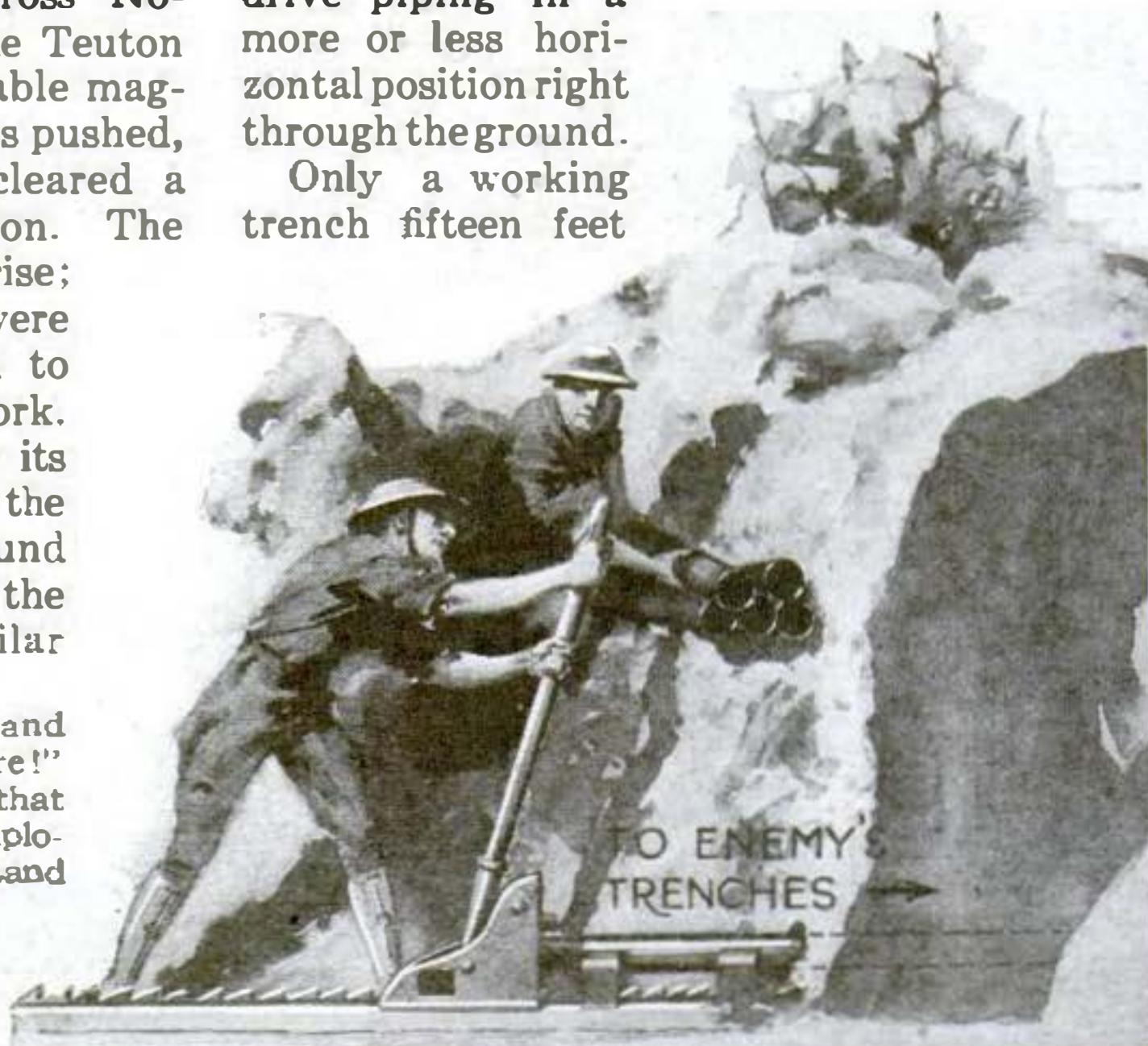
This ingenious tool has been used to drive piping in a more or less horizontal position right through the ground.

Only a working trench fifteen feet

long need be dug, so that the jack can be placed in position. The leading section of pipe is provided with a header or "pilot" that has a circular cutting edge. The pilot severs the roots of trees and kindred soft obstacles in its path. Ordinarily the jack lever is worked by one man; but two or more can unite their labors to speed up progress and to combat a more resistant soil.

In actual practice, the jack has been used repeatedly in driving piping a distance of three hundred feet or more. Where the earth is reasonably soft a still longer reach is practicable. Much of the ground on the Western front is susceptible of fairly easy penetration in this way. The pilot is followed immediately by a section or sections loaded with T.N.T., and each charge, by means of connections leading back through the piping, can be fired by the pressure of a key at the desired moment. There is nothing above ground to indicate what is being done. The advance of the piping underground is well-nigh noiseless. It is not necessary to wait for darkness. The work goes on steadily at any time.

"Another section, Bill, and we'll be under their wire!" Operating the jack that drives a pipe-line for explosives under No Man's Land



Terrific explosions of the T.N.T. pipe-lines smash the enemy's wire and clear the way for a charge



Engineering tricks learned in time of peace often come in handy on the fighting front

Shell-Torn Rheims—the City of Continuous Siege



What an airman saw of Rheims, the noted French Cathedral city, during the last big drive, when the Germans dropped shells into the town at the rate of 1400 a day. Ever since September 3, 1914, this ancient city has been under contin-

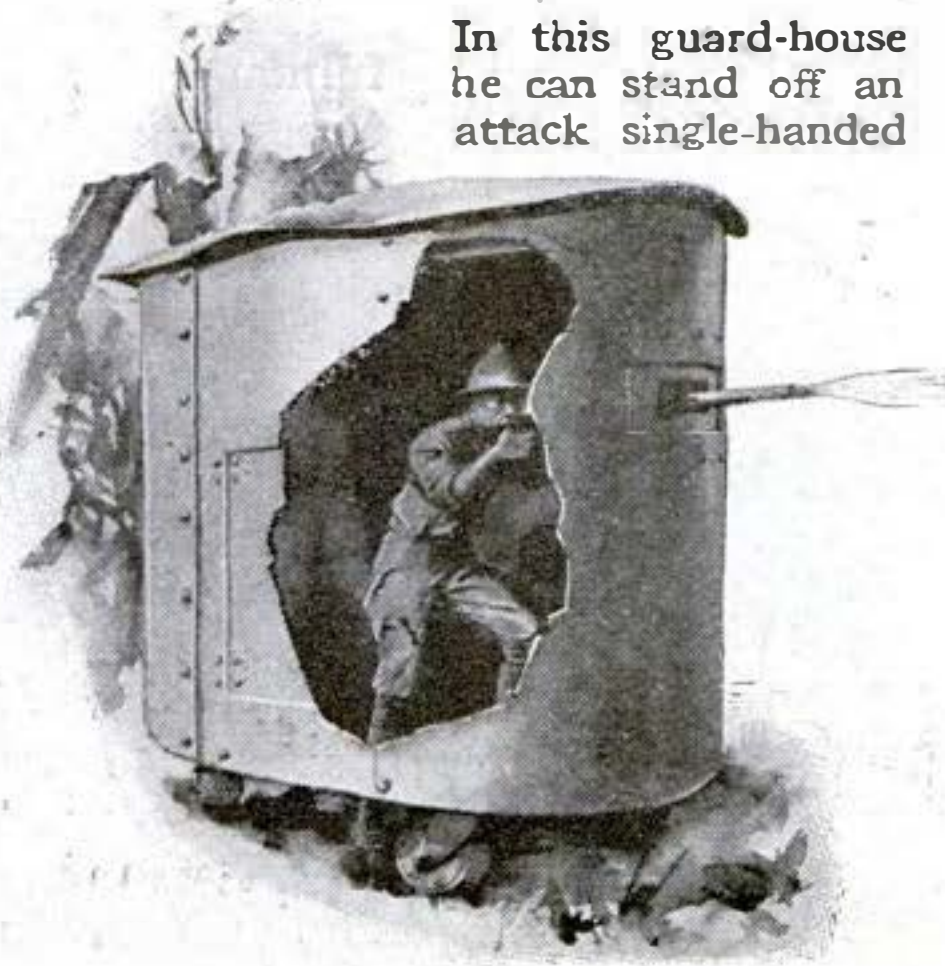
uous bombardment save for a few days now and then. In 1917, between April 1 and April 19, 65,000 shells fell in the neighborhood of the Cathedral. In one terrible early-morning hour 542 shells were dropped on the city

A Portable Armored Guard-House for the Sentry

WITH an armored guard-house or movable sentry-box, the stealthy attack and quick silencing of outposts, preparatory to a surprise and attack in force, may be frustrated. A less conspicuous but still very useful employment of such a device as that shown in the picture, is the guarding of property, such as military stores.

The general idea of a bullet-proof shelter for guards is not new, but certain features of the design embodied in this construction are interesting, notably the mounting of the house on wheels or large caster-like rollers. Another important feature is the facility with which it may be disassembled and packed for transportation, as well as the equally quick manner of assembling.

Other minor features comprise convenient shelflike platforms for the storage of rifles, ammunition, etc.



In this guard-house he can stand off an attack single-handed

Shooting at Birdmen Who Rain Death on the Trenches

WHEN the Italians, for the first time in history, used the airplane in war (it was during the African campaign of 1911), their Turkish enemies tried to cripple the aviators with rifle-fire from the ground. The Italian scouts paid less attention to the bullets than a horse to flies.

But in the present war the rifle has come into its own as an anti-aircraft weapon. For the rifle must of necessity be used when an airplane swoops down over trenches and sprays a line of hapless men with machine-gun bullets. Latterly this has become almost a practice with air-fighters who have failed to encounter an enemy machine. This practice explains the Italians in the accompanying picture.



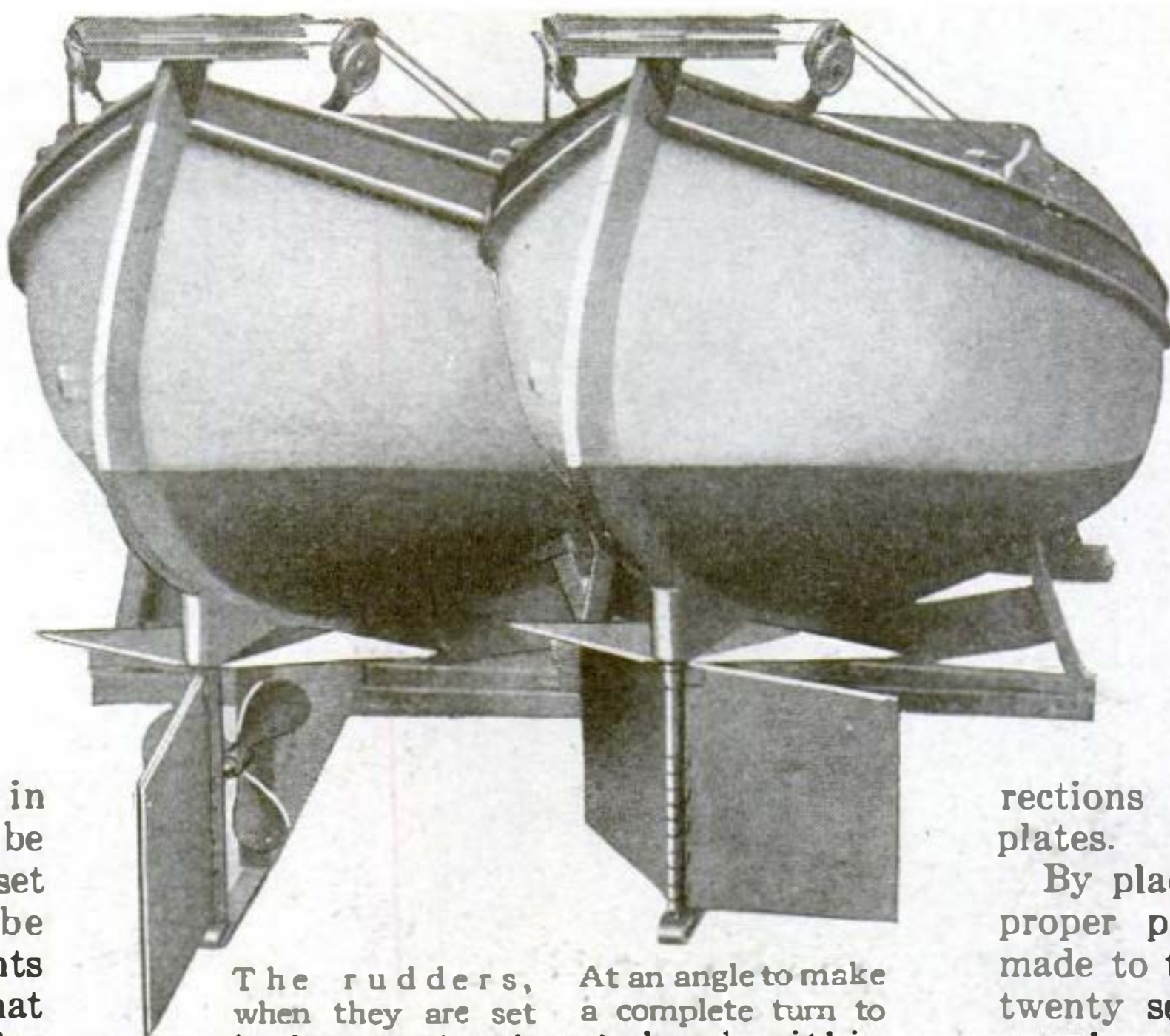
This practice is necessary in fighting off fliers who swoop down and fire on a trench

With This Rudder Torpedo-Dodging Would Be Easy

ONE of these days you will be able to step into your motor-boat, set the engine running, and then forget about it. All further direction of the boat—slowing down, stopping, and going astern—will be controlled by the rudder. Deputy State Engineer W. B. Landreth, of New York, has a boat that can do all this. He has had installed in it a reversing and control rudder, the invention of H. O. Westendarf, of Boston.

A steam-turbine of the kind used on big ships runs in only one direction. It can't be reversed. Hence an extra set of reversing turbines must be installed. Westendarf wants to do away with these, and that is why he invented his peculiar rudder. If it works as well on large craft as it does on small, it won't be long before the man on the bridge of an ocean liner will be able to dodge torpedoes with all the skill of a football half-back running through a broken field.

This masterful rudder is really two rudders, twins, made of steel plates



The rudders, when they are set in the normal position for cruising. At an angle to make a complete turn to starboard within its own length

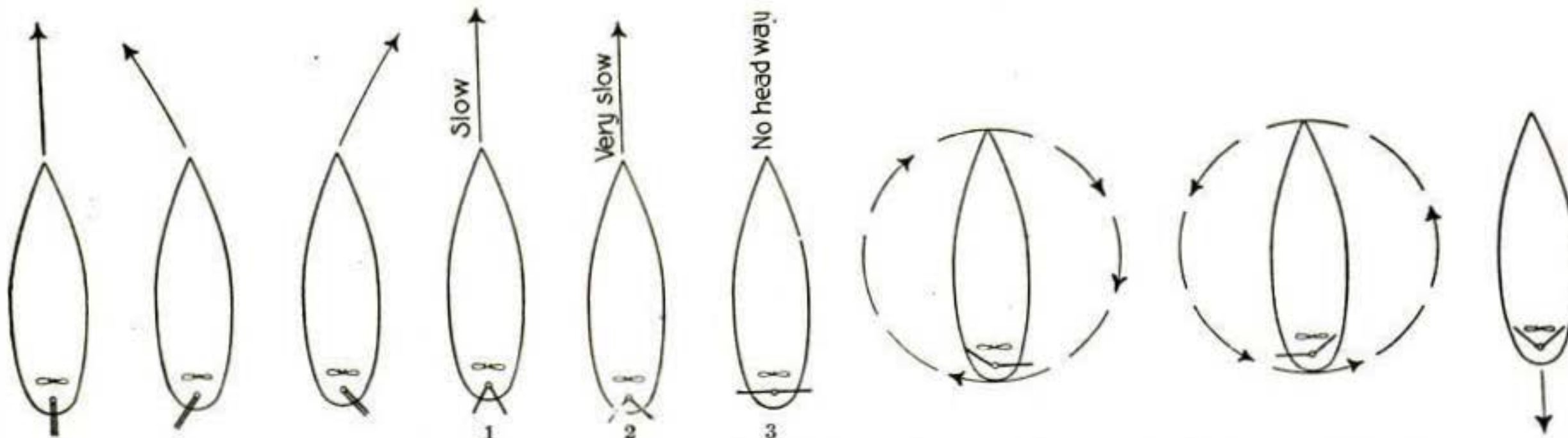
three sixteenths of an inch. Each plate is the same size as the normal rudder used on this type of boat. The rudder-post is a steel rod inside of a steel tube. One plate of the rudder is attached to the tube, while the other is attached to the rod.

To control this two-leaved rudder the boat is equipped with two steering-wheels, one to direct the rudder affixed to the tube, and the other, that fastened to the rod. The two wheels are on the same axis, and, when locked together, operate as one when ordinary steering is to be done. But when the boat is to be turned about sharply, stopped, or sent astern, the wheels are released so that they may be revolved in opposite di-

rections to manipulate the rudder-plates.

By placing the rudder-plates in the proper positions, the boat can be made to turn within its own length in twenty seconds, come to a stop, and remain stationary or go astern—all while the engine is still running full speed ahead.

Mr. Landreth's boat has been brought from full speed ahead to backing in the space of nine seconds. With the reversing gear that was originally installed in the boat it took twenty-six seconds to complete this maneuver.



The rudder plates locked together to direct the boat in the ordinary way.

In Fig. 1 the rudders are set for slow speed ahead. Fig. 2 shows the position for very slow ahead, and Fig. 3 for full stop

Placing the rudders in this position causes the boat to make a complete turn within its own length

When the rudders are set in the V shape (shown in the diagram at the extreme right), the boat, with the propeller running full speed ahead, stops almost instantly and begins to back. The backing movement is caused by the stream of water thrown back against the rudder by the propeller and thus projected forward along the sides of the boat toward the bow. The force of this stream is sufficient to propel the boat back at 30 per cent of its full speed ahead

Mr. Rockefeller, Take Notice of the Fulmar: the Animated Oil-Can

THE price of coal-oil is a matter of no interest to the inhabitants of the island of St. Kilda, a favorite haunt of that animated oil-can, the fulmar. So rich in oil is this sea-bird that the natives simply pass a wick through its body and use it as a lamp.

The oil is also one of the principal articles exported from the island.

It is found in the birds' stomachs, is amber-colored, and has a peculiarly nauseous odor. The old birds are said to feed the young with it, and when they are caught or attacked they lighten themselves by disgorging it.



They pass a wick through it and use it as a lamp

In St. Kilda it is legal to kill the fulmars only during one week in the year; but during that week from eighteen to twenty thousand birds are destroyed.

Another competitor of the Standard Oil Company is the mutton-bird of the Antarctic. Its oil is also carried in the stomach, and can be ejected through the nostrils as a means of defense against the bird's enemies.

Quantities of mutton-birds are slaughtered every year for their oil on the coasts of Tasmania and New Zealand. In its composition and properties this oil closely resembles sperm-oil.

How Ford Builds Submarine-Chasers in a Factory

The "Eagles" Are Built Like Ford Automobiles, with Unskilled Labor, on the Progressive Assembly Plan

By Frank Parker Stockbridge

ON July 11th there was launched at the Ford shipyards, on the River Rouge, near Detroit, the first of the new Ford "Eagle" boats. It was not until last January that the idea of building vessels by the quantity-production method long ago adopted in making automobiles was conceived. The construction of the plant was begun in February. Ships are now being turned out at the rate of one a day.

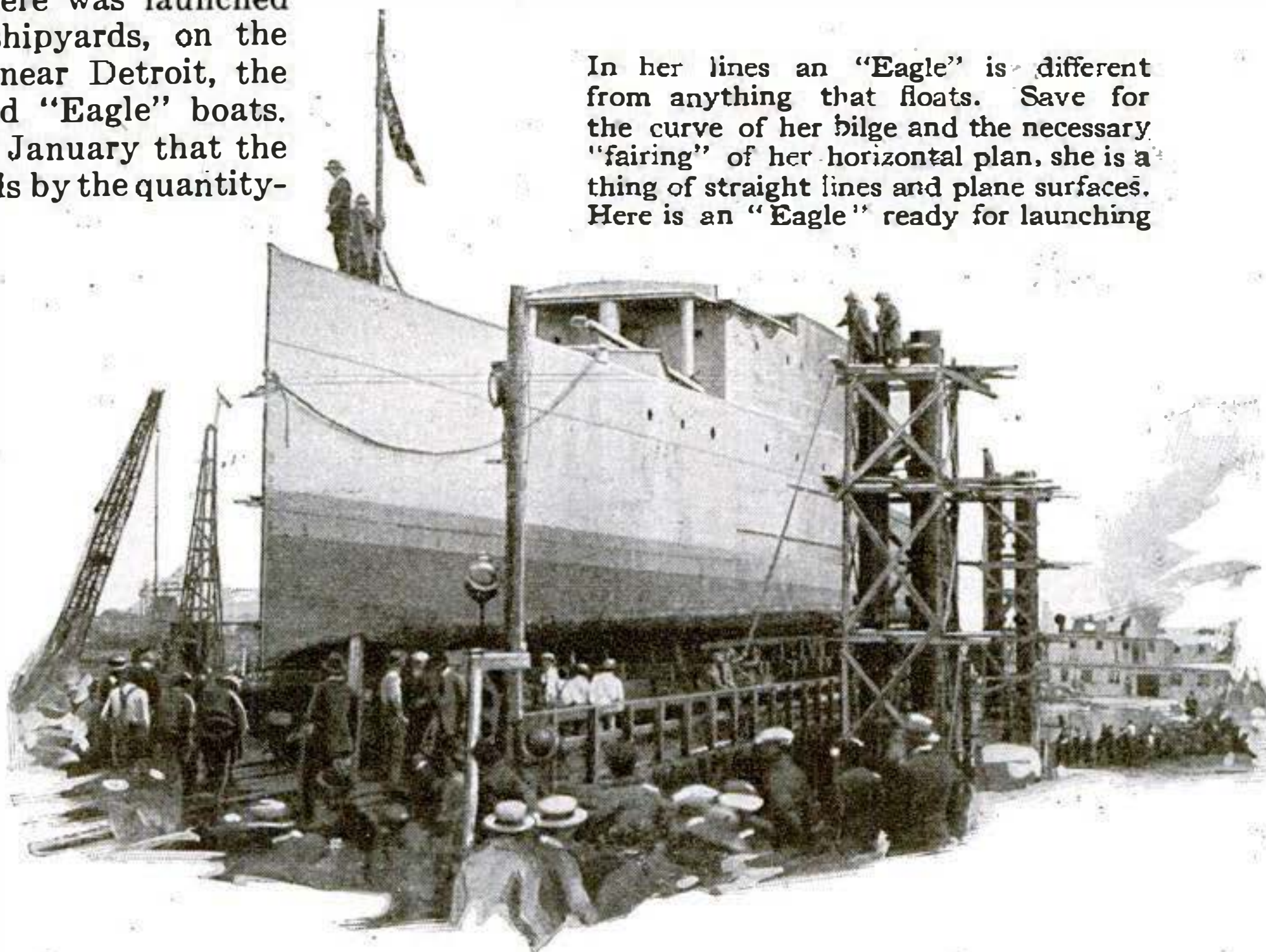
The "Eagle" boat is, in fact, a destroyer without torpedo tubes and with less engine power. Consequently it is slower than the high-powered little bull-terriers of the sea, with their 27,000 horsepower and thirty-knot gait. But it will have speed enough to run circles around the fastest submarine cruiser, and it will carry guns and depth-bombs similar to those of destroyers—the most formidable weapons thus far devised for combating U-boats.

Designed by the Navy Department

What was needed was a steel vessel so designed that its component parts would not require the diversion of any steel production needed for other war purposes, big enough for any weather, fast enough to catch any submarine.

The design of the "Eagle" boat was worked out in the Navy Department. It took only three weeks to make the plans, build a model, test the model for stability and speed in the testing tank at the Washington Navy Yard, and draw up specifications for

In her lines an "Eagle" is different from anything that floats. Save for the curve of her bilge and the necessary "fairing" of her horizontal plan, she is a thing of straight lines and plane surfaces. Here is an "Eagle" ready for launching



construction. In its lines the "Eagle" boat (that is the official designation of the entire class) does not exactly resemble anything else that floats.

Lines of the "Eagle" Boats

Save for the curve of the bilge and the necessary "fairing" of the horizontal plan, it is composed entirely of straight lines and plane surfaces; yet there is a fine sweep to the lines that gives promise of all the speed the craft is likely to require, flat-bottomed

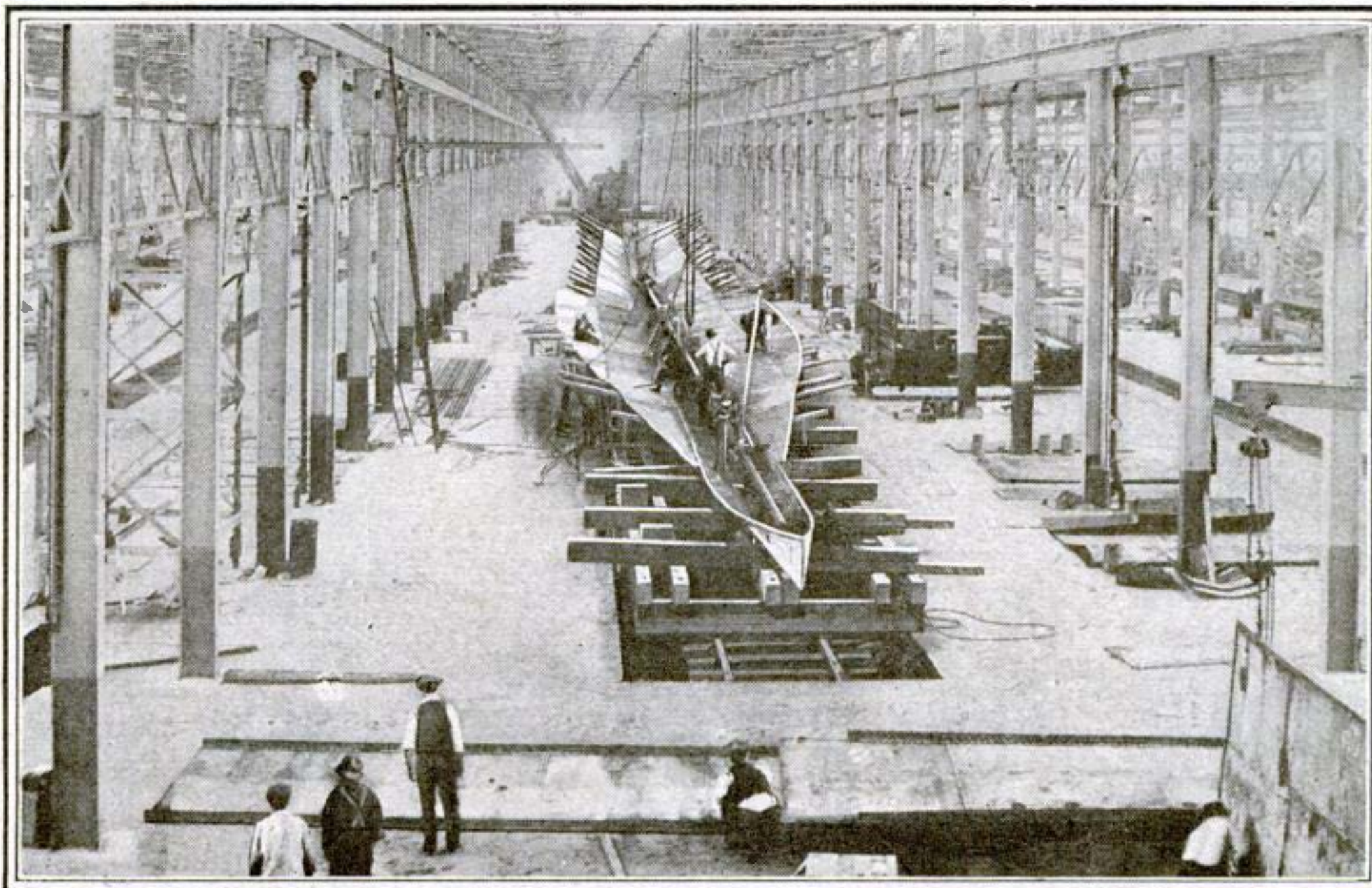
than the width of the locks.

The motive power of the "Eagle" boat is a 1400-steam turbine geared to the propeller shaft, on which is mounted a three-bladed screw of rather steep pitch. Oil fuel will be used to generate the steam, and enough of it will be carried on each "Eagle" for a voyage across the Atlantic. Turbines were adopted for the "Eagle" boats, as they have been for the new destroyers and most of the ships of the new merchant fleet, because they occupy less space for the same horse-power than do reciprocating engines.

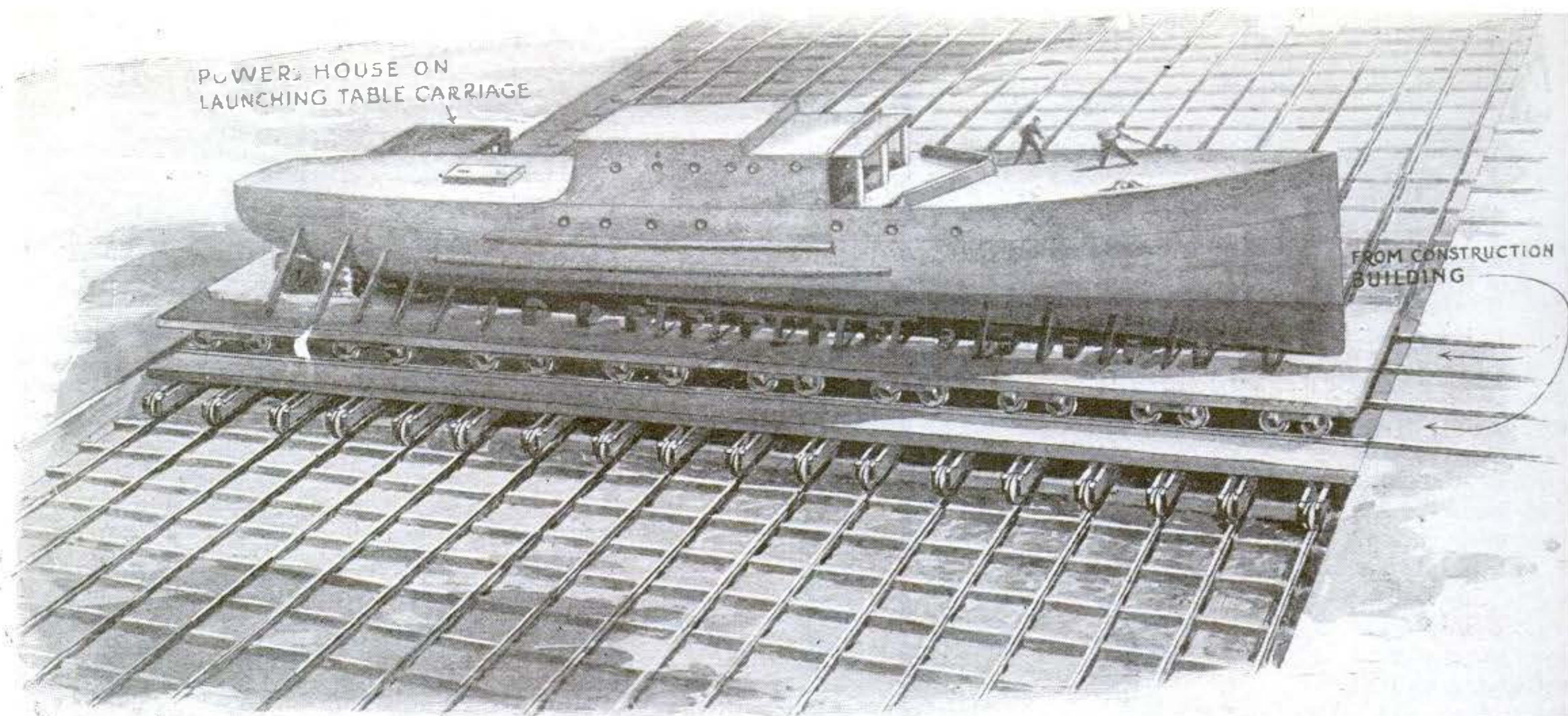
A Boat Built of Pressed Steel with No Curves

The "Eagle" is not only an entirely new type of naval craft, built on brand new lines, but the method of building it is radically different from anything that has ever been attempted before.

In the whole ship there is not a forging or a rolled beam

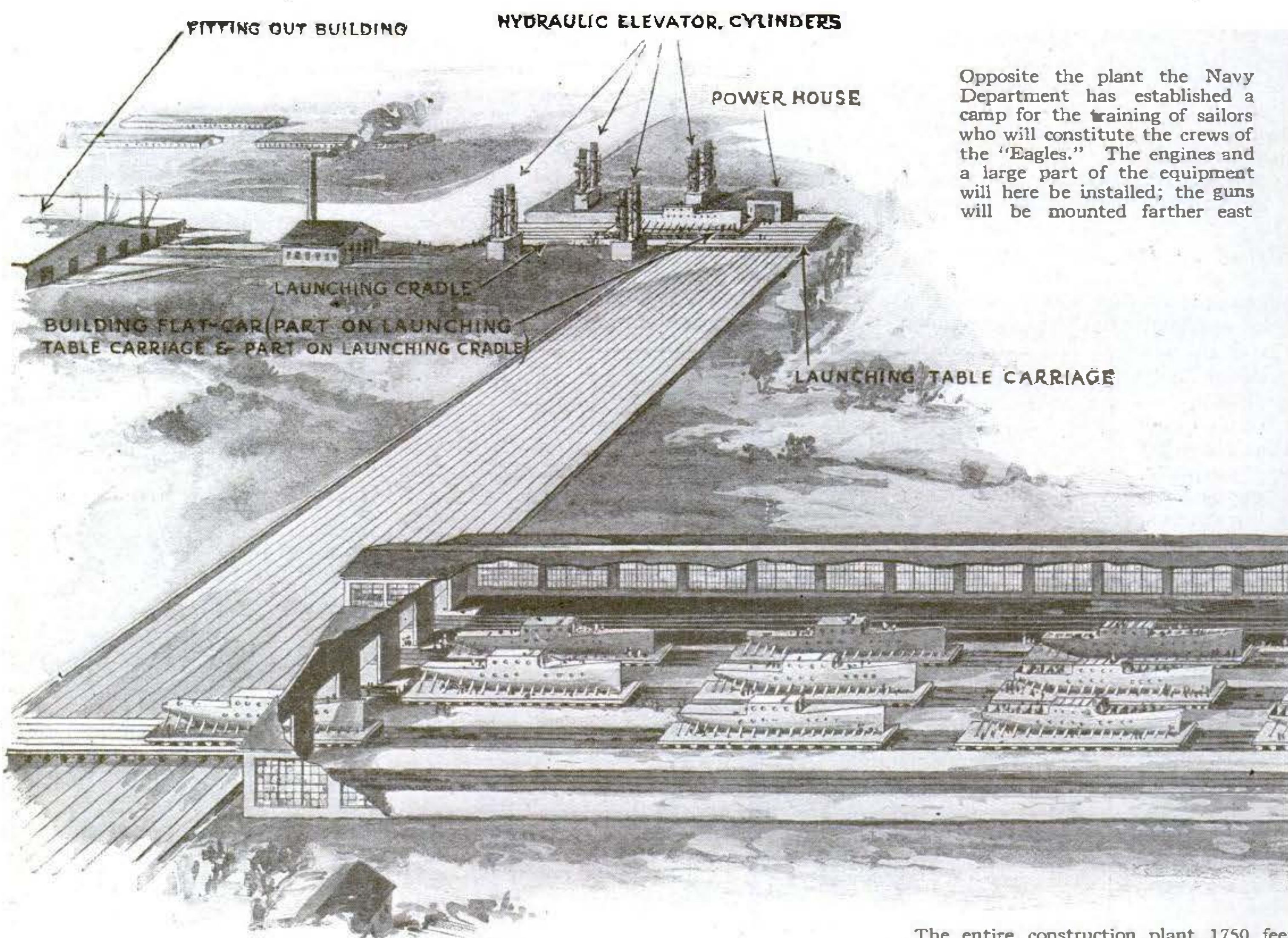


The "Eagles" are built like automobiles—on the progressive assembling system. The keel is laid on a flat car. That flat car passes down the shop to crews of men who perform special tasks. Thus a vessel is built up as it moves from crew to crew



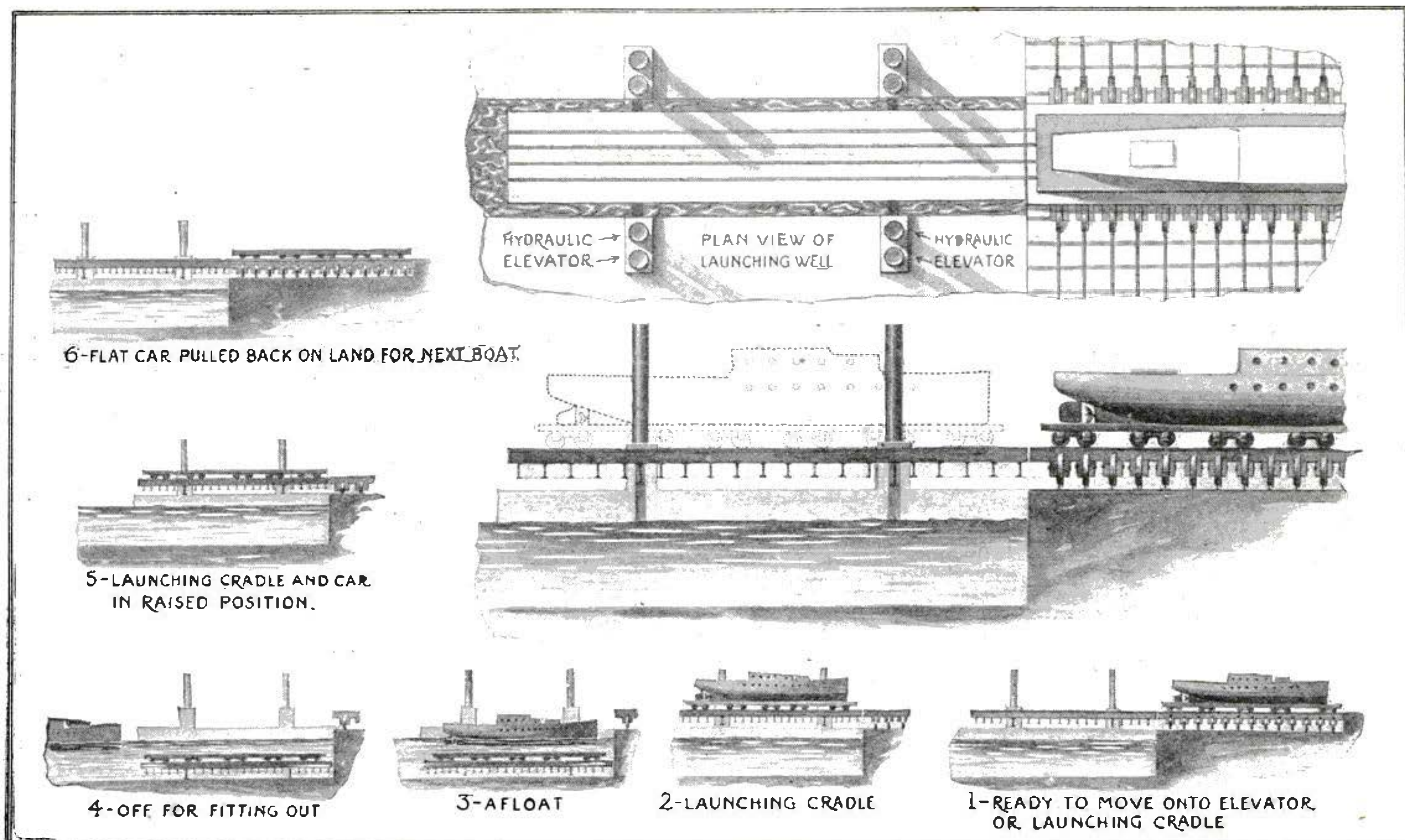
As soon as an "Eagle" is ready for launching, the flat car on which she was built is run upon a launching-carriage, which is, in effect, another flat car with a propelling power plant. The tracks leading to the launching basin run at right angles to the tracks leading from the shops, as this picture shows. The boat itself is 204 feet

long, and is built on a flat car 220 feet long. Never in the history of shipping has a vessel been constructed on so daringly new a principle. Thousands of boats very much larger than the ships in which Columbus and the Mayflower pioneers came to America are being built in a factory, very much on the plan of the Ford automobiles



Opposite the plant the Navy Department has established a camp for the training of sailors who will constitute the crews of the "Eagles." The engines and a large part of the equipment will here be installed; the guns will be mounted farther east

The entire construction plant, 1750 feet long, in which the "Eagles" are built, is nothing but a special transportation system.



Every shipbuilder holds his breath during the critical moment of launching. When the vessel is safe in the water he mops his brow in relief. Launchings do not

worry Ford. He simply drops an "Eagle" into the water on the largest hydraulic elevator in the world. It's just as easy as coming down from the tenth floor of an office building

or shape. Everything—keel floors, frames, beams, and angles—is pressed from sheet metal, cold, by means of automatic machinery that cuts every piece to an exact pattern, then punches the rivet-holes, thirty or forty at a time, and bends every part to its precise final shape. Building a ship by this plan is merely a matter of fitting numbered parts and riveting them together.

Stretching a third of a mile along the banks of the River Rouge, the steel, glass, and concrete building in which the "Eagle" boats are built, 1750 feet long, 350 feet wide, and 100 high, covers more than thirteen acres in one room.

It is so big that looking at a 200-foot ship at the other end of the room is like looking at a figure on the stage

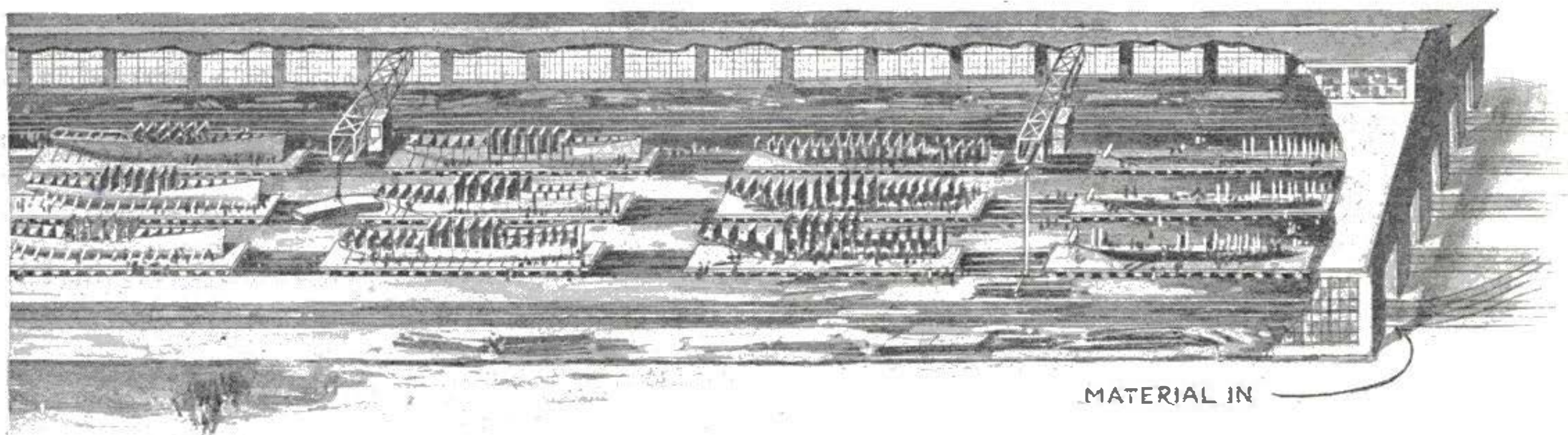
through the wrong end of an opera-glass. At one end is a shed under which the steel is stacked in piles.

Where the Boats Are Built

They are impressively thin, these plates—a trifle thinner than the plates of regular destroyers. Here is another building, a big, open floor, on which men are laying down patterns on sheets of steel and marking them for the cutting and punching machines; and here are big stamping-presses bending certain of the sheets and strips into angles and channels. Close to the door are the punches, making at one blow thirty or forty rivet-holes—each at a point precisely determined in advance—in the edge of a steel plate.

The entire Ford plant in which the "Eagles" are built is nothing but a special transportation system. In quantity production the work is fed to the workman at regular intervals. He does one thing only in a standard, determined time. He has time enough, but not time to loaf. If he loafs he is overwhelmed with an avalanche of work.

Hence the inside of the main building looks like a huge railroad station, because of the lines of railroad track running through its length. There are trains of flat cars, apparently, standing on three of the tracks. On close inspection, however, what seemed to be a train proves to be a single huge flat car, or platform, about 225 feet long and perhaps 20 feet wide. It is upon these rolling platforms that the "Eagles" are built. On each of the three



The boats are built on flat cars, travel progressively on railway tracks from shop crew to shop crew, are thus assembled, and leave the building, as shown, in order to be received (flat cars and all) on

a launching-carriage. By means of the launching-carriage they are transported on rails to a hydraulic elevator which lowers them into the water. The drawing shows seven stages of construction

assembling tracks seven "Eagle" boats are under construction at a time—twenty-one in all. The work has been so laid out that each ship moves down the line in orderly progression, ready for a new set of operations to bring it one more step toward completion.

Building Boats on Flat Cars

The rails lead to a big, heavy-framed platform as long as the building is wide and as wide as an "Eagle" boat is long. This platform is, in turn, mounted on car wheels, which run on rails placed at right angles to those out of the building. These rails extend several hundred feet beyond the structure.

When an "Eagle" boat is ready for launching, it is moved with its platform, trucks, and all, out upon this transfer or turntable. That, in turn, is hauled across until the rails supporting the boat come opposite a pair of rails that lead to another platform, which is apparently supported between four large vertical tubes.

This platform is in reality the largest hydraulic elevator in the world. In many respects it is the most remarkable detail in the whole Ford plant. Its operation is exactly similar to that of the ordinary hydraulic elevator in a tall building. Plungers or pistons moving in cylinders are operated by means of the pressure of a column of water, this pressure being raised by pumps to lift the load, and lowered by the opening of valves when it is desired to let the load down.

There are four of these hydraulic cylinders, one in the inside of each of the four concrete pillars. When the platform on its trucks, with the "Eagle" boat mounted on the platform, is lowered on the elevator, the total weight supported by these four columns of water is approximately 2,000 tons, or in the neighborhood of 4,000,000 pounds. This is a rather sharp contrast to the placards so frequently seen in the elevators of office buildings: "Capacity 3,000 pounds."

The building of this elevator proved to be one of the most troublesome

tasks in connection with the construction of the plant. As a matter of fact, there was an "Eagle" boat ready for launching nearly two weeks before the elevator was completed. It was not that there was any special difficulty involved from an engineering viewpoint, but at the point where one of the caissons was sunk for the concrete work, quicksand was encountered. Although a very heavy foundation for this particular pillar was put in, after it had been completed it tilted sufficiently from the perpendicular to necessitate digging down almost to the foundation again where the water was shut off by means of a coffer-dam, and straightening the huge block back to a vertical position.

While the "Eagle" boat draws only eight feet of water, it was necessary to have more than double that depth of water in the launching basin, so that the elevator itself and the truck-supported platform could be lowered below the point of the boat's buoyancy. The foundations of the hydraulic pillars go down more than thirty-five feet.

Launching Boats from Elevators

The lowering of an "Eagle" boat into the launching basin is as simple as descent in an ordinary office elevator. After the boat has been floated off the truck, the elevator is raised again to the main level by hydraulic power. The truck is shunted to the farther end of the building, and in half an hour the

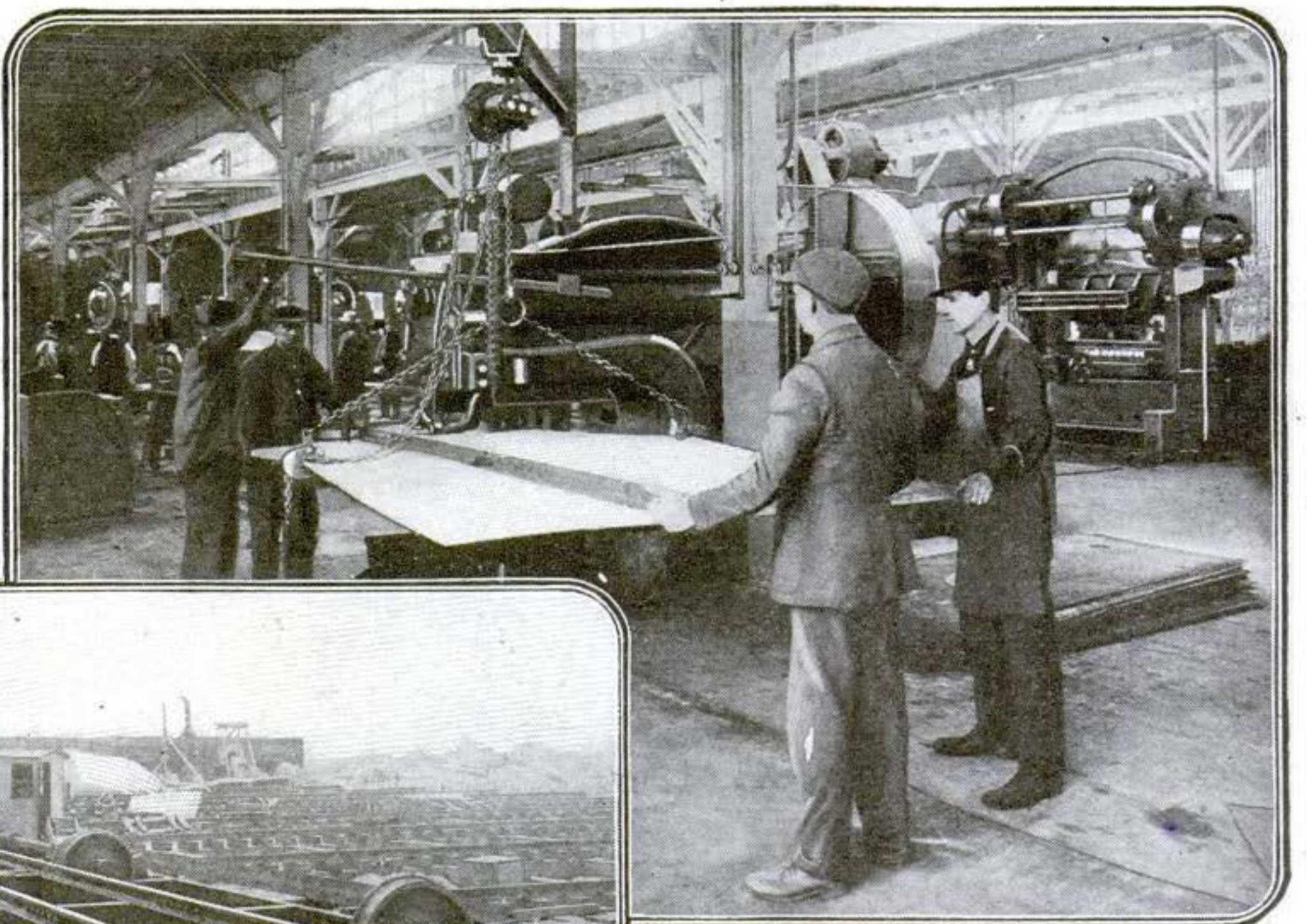
six other "Eagle" boats on the track from which the last one was taken have each been moved up a notch, and the platform is back, ready to receive the keel of another ship.

Opposite the "Eagle" plant, the Navy Department has established a camp for the training of sailors who will form the crews of the "Eagle" boats.

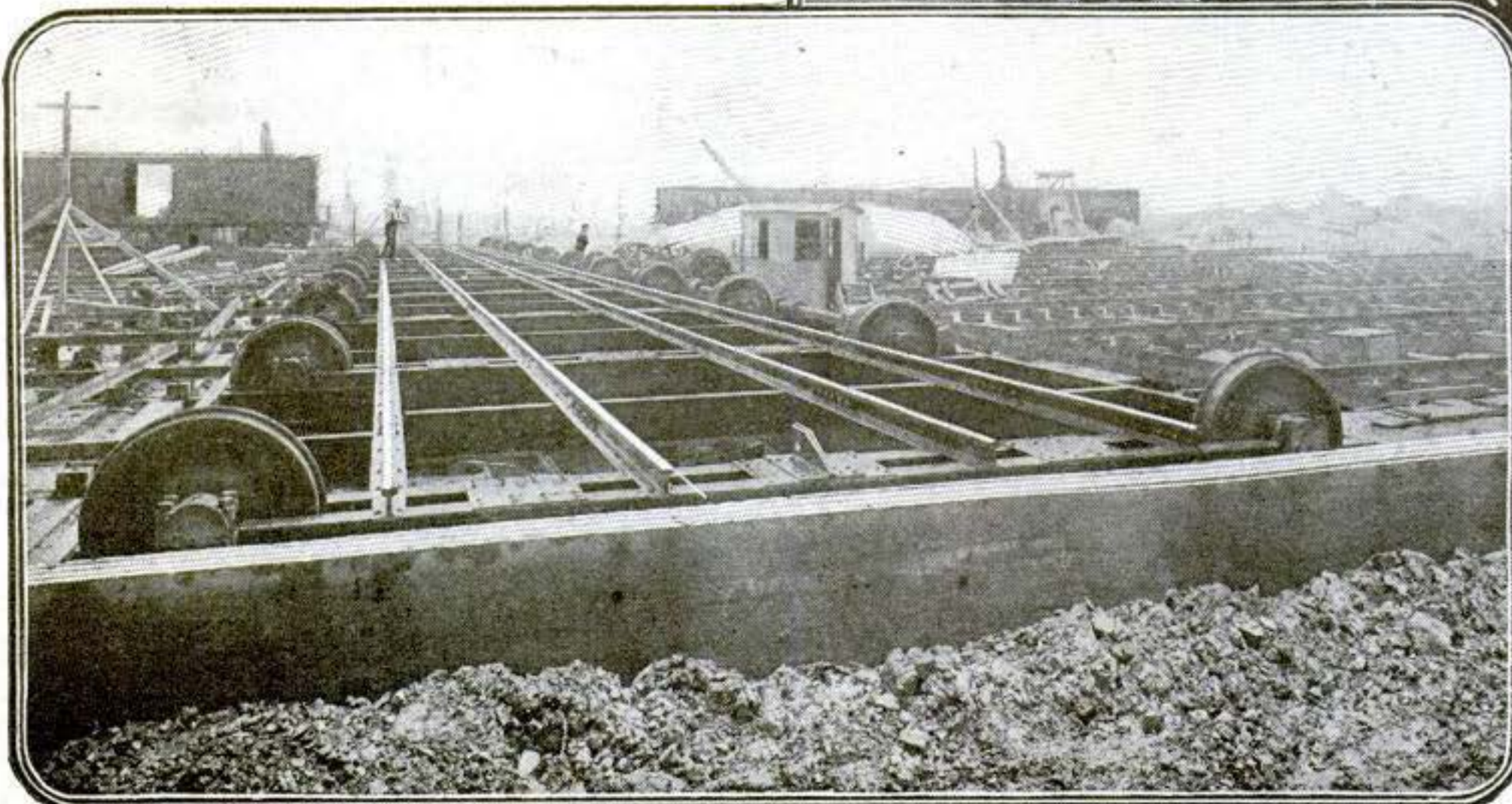
Efficiency of "Eagle" Boats

There is no ground to doubt the efficiency of this type of craft in the warfare on the submarine. The splendid service that was rendered in the early days of the war by the 85-foot motor-boats built in America and assembled in Canada for the British Navy proved the usefulness of small craft. These 85-foot boats, however, were really not big enough to be fully seaworthy, and early in 1917 our Navy Department began building similar craft, 110 feet long, and used them as submarine patrols.

The most efficient work against the submarine, however, has been by our destroyers, equipped with quick-firing guns and apparatus for discharging depth bombs. The "Eagle" comes between the 110-foot chasers and the destroyer, and by this time next year there will be at least two large fleets of them in commission. The Secretary of the Navy recently asked Congress to authorize the appointment of several additional Rear-Admirals, saying that he would require the services of at least two of them to command squadrons of "Eagle" boats.



Everything is pressed from sheet metal and then punched for rivet-holes, thirty or forty at a time



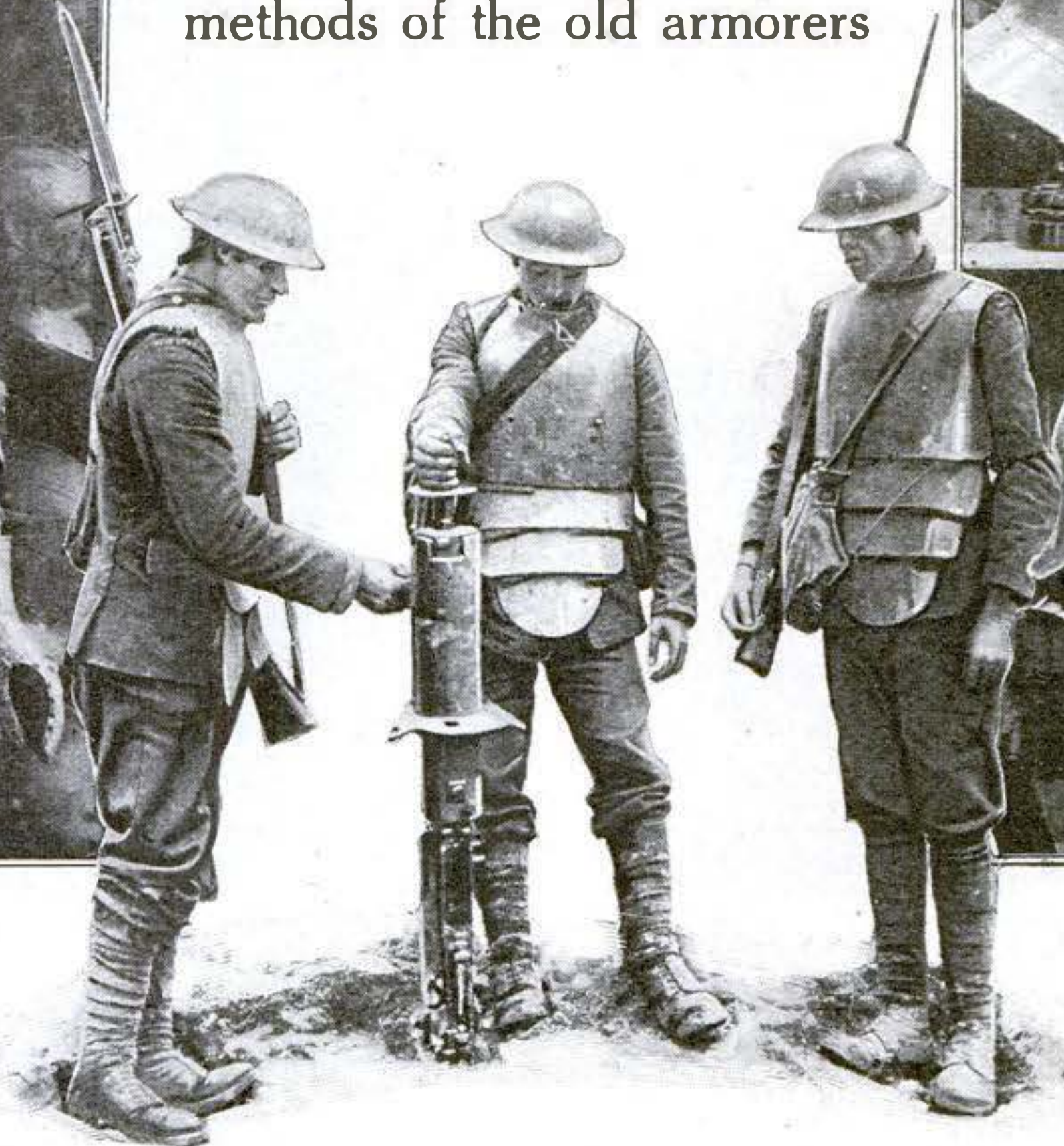
The entire factory is a huge transportation system. This is the railway on which the "Eagles" are carried to the launching elevator

Let Hammer on Anvil Ring

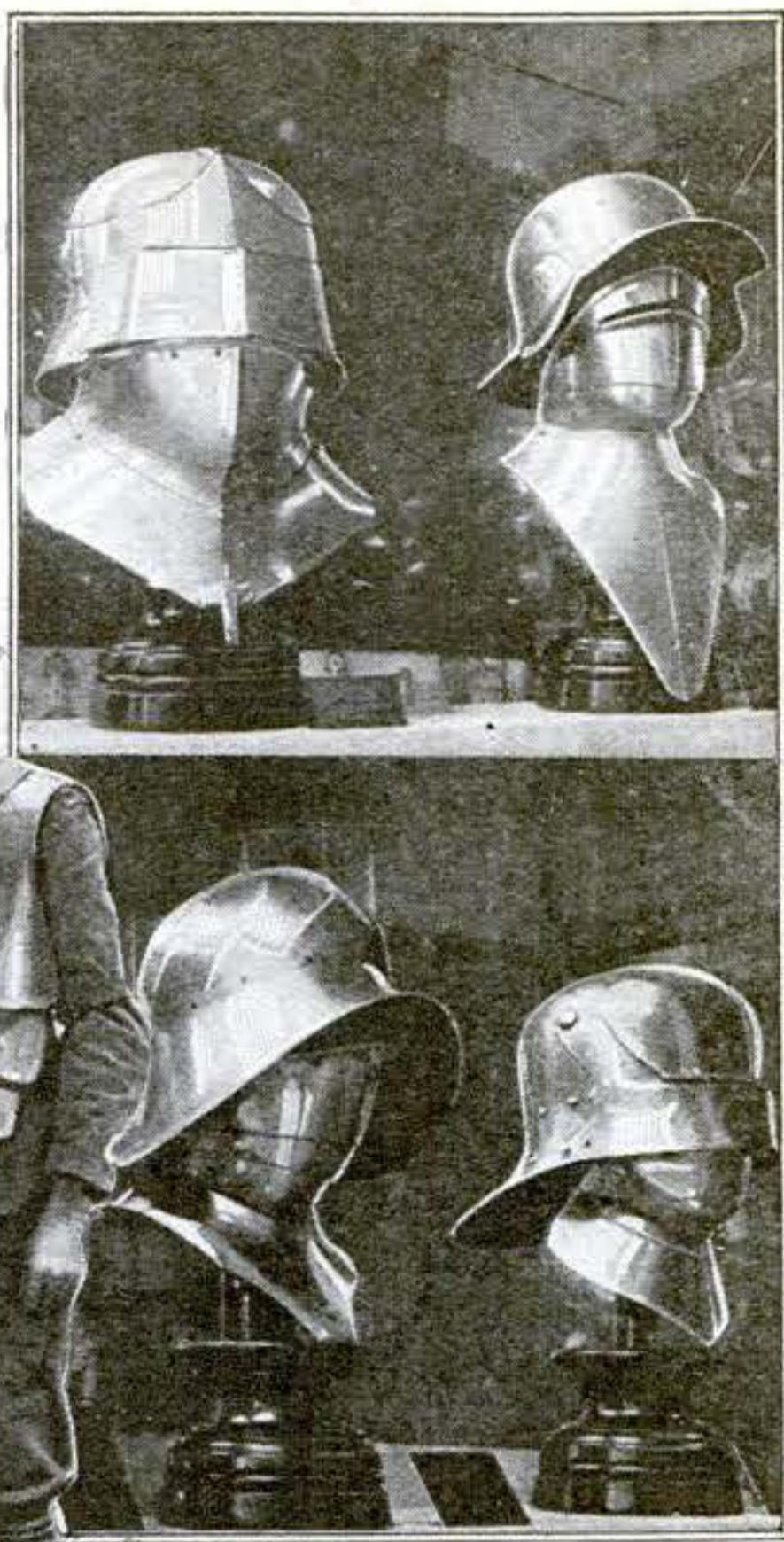
The Great War has revived the use of many medieval weapons. That's why it has become desirable to study the methods of the old armorers



Some German knight wore this about 1550. The helmet is made as human in appearance as possible, and at the same time as fierce. It has a Hohenzollern look—hasn't it, this headpiece of an old knight? The Japanese carried out the same idea of intimidation in their armor



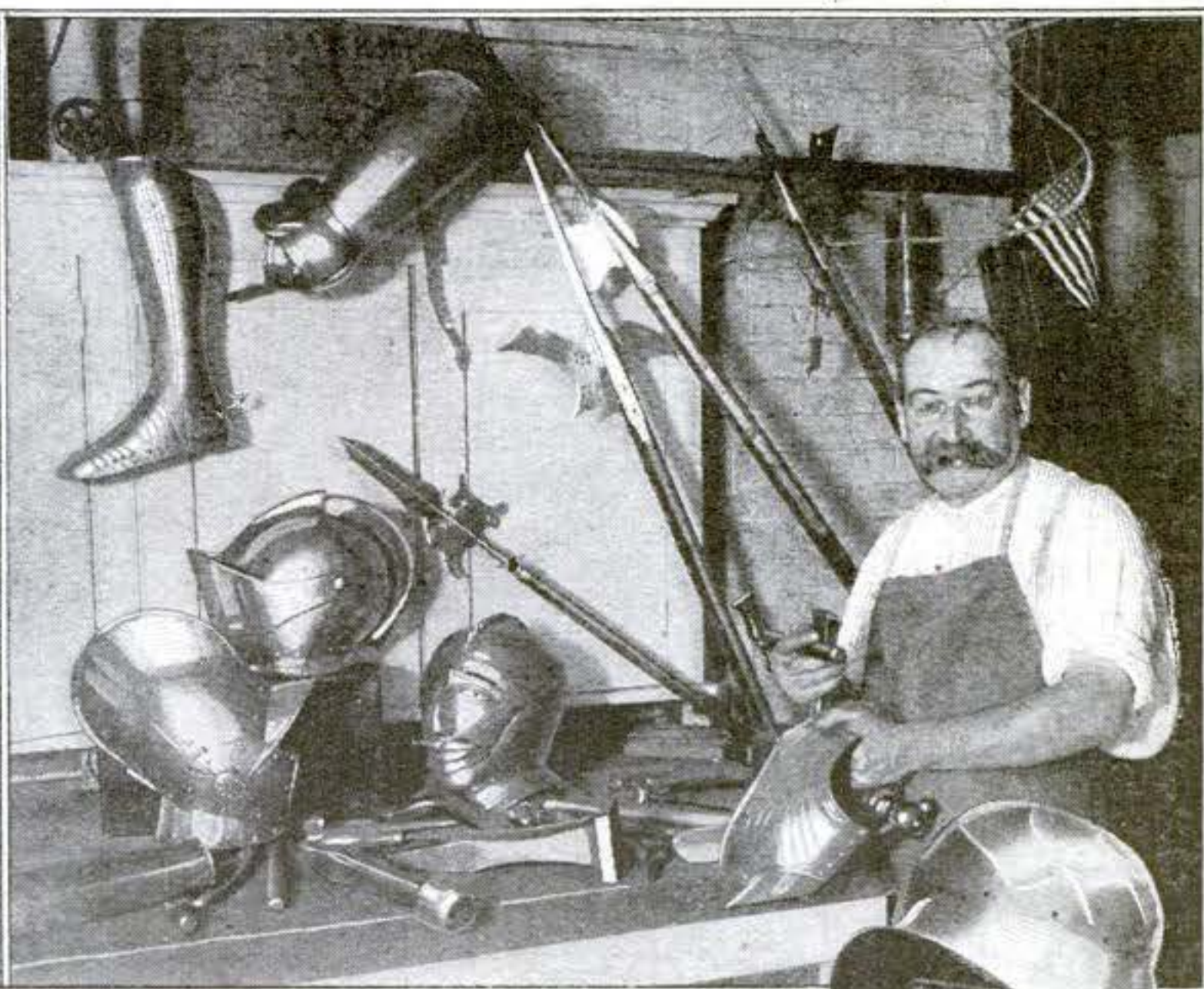
The Germans are wearing heavy breastplates and the English lighter breastplates for attack. Here are three Irish Guards wearing German body armor. Is it any wonder that the United States army is studying old armor?



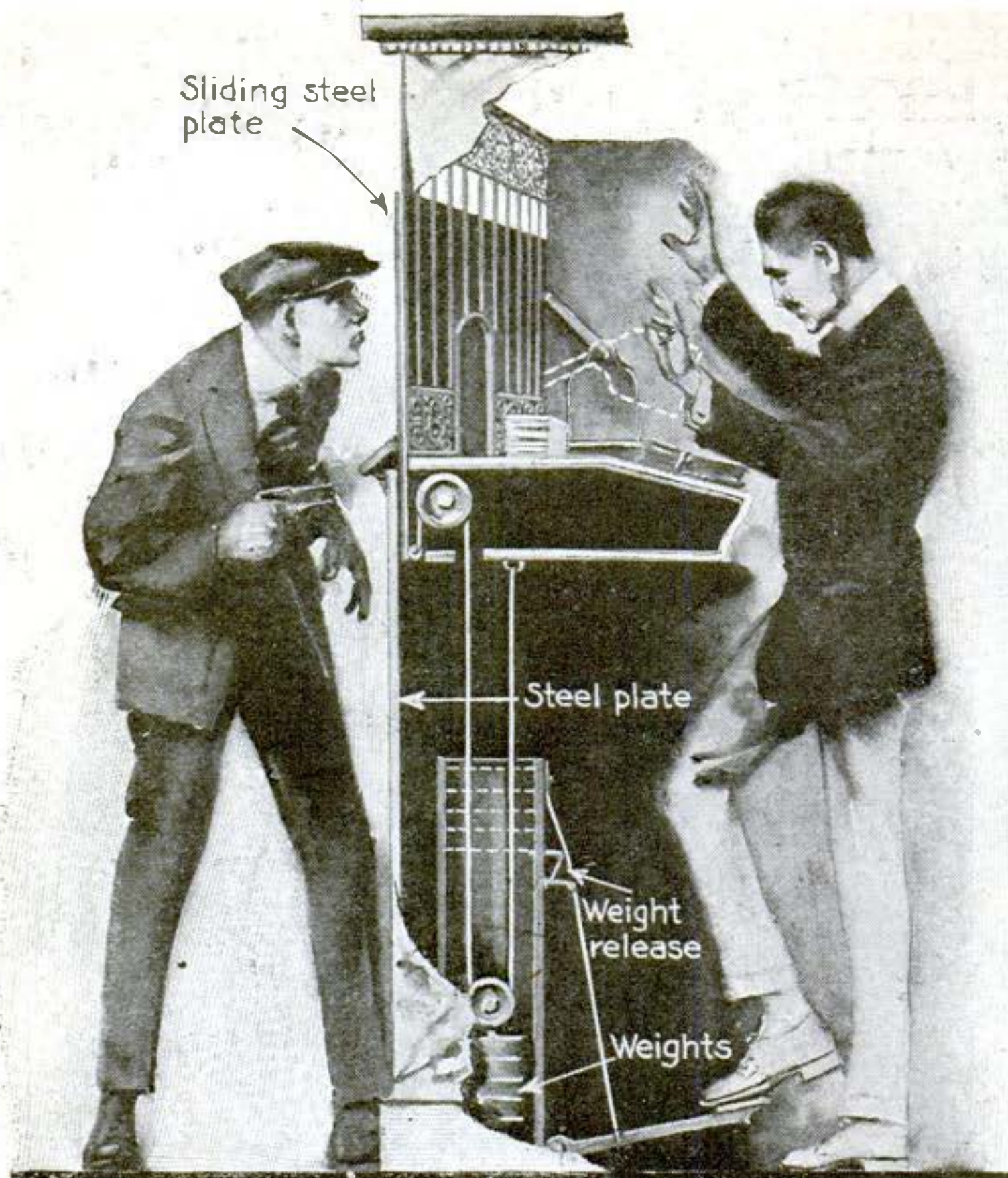
Four helmets in the collection of the Metropolitan Museum of Art, dating back to the fifteenth century. They were evolved at a time when gunpowder had been introduced, and so were designed to resist the bullets of early weapons. Hence they are valuable objects of study



The Metropolitan Museum of Art brought this old armorer's workshop of the fifteenth century from Abbeville, France. The anvil dates from the early sixteenth century. All the tools are old, but are still used to repair armor. On the wall is a bust of St. Eloi, the patron saint of all armorers. The bench vise at the left is of seventeenth-century workmanship. This armorer's workshop is used for cleaning, repairing, and in some cases restoring old mail



Here Daniel Tachaux, Master Armorer of the Metropolitan Museum of Art, smiles at us. M. Tachaux is one of about six men in the whole world who has kept alive the ancient armorer's art. He is now actively engaged in assisting the United States Army to develop a type of armor for our shock troops. And so we in the twentieth century turn for guidance to such old masters of the science of armor design as Leonardo, Giulio Romano, Cellini, Holbein, Dürer, and Michelangelo



To be sure, the bank teller is throwing up his hands, but his foot, taking the opposite direction, presses a concealed trigger that completely surrounds him with armor

Surround Yourself with Armor When You Hear "Hands Up"

THE up-to-date bank robber will have to steal a march on the military geniuses of the age if he has any hope of accomplishing his designs. For Mr. Walter Watson Arnold, of Dawson, New Mexico, has invented and patented an armor-plate cage for bank tellers.

"Hands up!" says the gentlemanly robber, and is obeyed with the expected alacrity. But the bank official's foot surreptitiously releases a spring that causes sliding doors of armor-plate to move into place and encase him.

Adjustable plates fixed over the openings in a teller's cage are connected by a system of cables and pulleys with some stationary member attached beneath the desk. When not in use, a trigger engages sectional weights applied to the pulley. This trigger is connected with the arm of a bell crank lever, the other arm of which is connected with a rod or cable that is again attached to the foot lever.



Why this rapt study of the board? It is a luminous indicator that shows what seats are vacant in the theater. When you take a chair a corresponding light on the board goes out

Every Man His Own Usher: For Moving-Picture Theaters

NO longer need the "movie fan" have to stand waiting in crowded and uncomfortable darkness until the usher can show him to a seat; no longer need he let the usher choose his seat for him—that is, if his theater is equipped with the "vacant seat detector" invented by John E. Johnson.

On entering a theater equipped with a vacant seat detector, you are confronted with a large seating diagram. Each vacant seat is indicated by a light. When, having chosen your place, you sit down, you extinguish the light.

By a simple mechanism, the indicator board is connected with every seat in the house. The illumination is obtained by perforating the diagram with holes, through which shines the light of an electric lamp. Each hole on the diagram, representing a seat, is equipped with a revolving shutter turning under the influence of an electromagnet connected with the corresponding seat.

The Horse Has a Small Appetite in Comparison with the Caterpillar

MANY diminutive animals eat more than their weight of food each day.

A caterpillar will gorge itself on twice its weight in leaves, while the little potato-beetle manages to consume five times its weight of juicy green things in one busy day.

If a horse ate as much as a caterpillar in proportion to its



This is not a monster from the banks of the Ganges, but only a drawing to show how big a caterpillar would be if its size had the same ratio to its food as has that of a horse

size, it would require a ton of hay each day.

If a baby were as voracious as a young potato-beetle, it would need one hundred pounds of food between one sunrise and the next.

If an elephant's appetite outweighed him every twenty-four hours, not even the most prosperous circus could afford to keep one.

Riders of the Air Elephants

In huge bubbles of gas, a mark for hostile bullets, the balloon observer watches the enemy

THREE times Sergeant Charles Debas of the French army was cited for conspicuous gallantry. The third time he was cited thus:

"A balloon observer of the first rank, who, during ascensions totaling 450 hours, has displayed remarkable courage and energy. Attacked by an airplane at dusk and wounded in both legs, he jumped in a parachute, and, in spite of his wounds, reported at once on the observations that he had just completed."

The official citation did not mention that in his perilous descent the sergeant stopped his gushing wounds in order to retain sufficient consciousness to report observations that might mean the capture of a line of trenches.

Hundreds Like Debas

Nearly a year elapsed before Debas rejoined his old company—still limping. When he went up again, last April, he was attacked by three enemy fliers. The soldiers below saw him raise his rifle and fire round after round. They telephoned to him to leap for his life. No answer. Incendiary bullets fired by the German fliers ignited the huge gas-bag. It came down in roaring flames. They picked up Debas, dead.

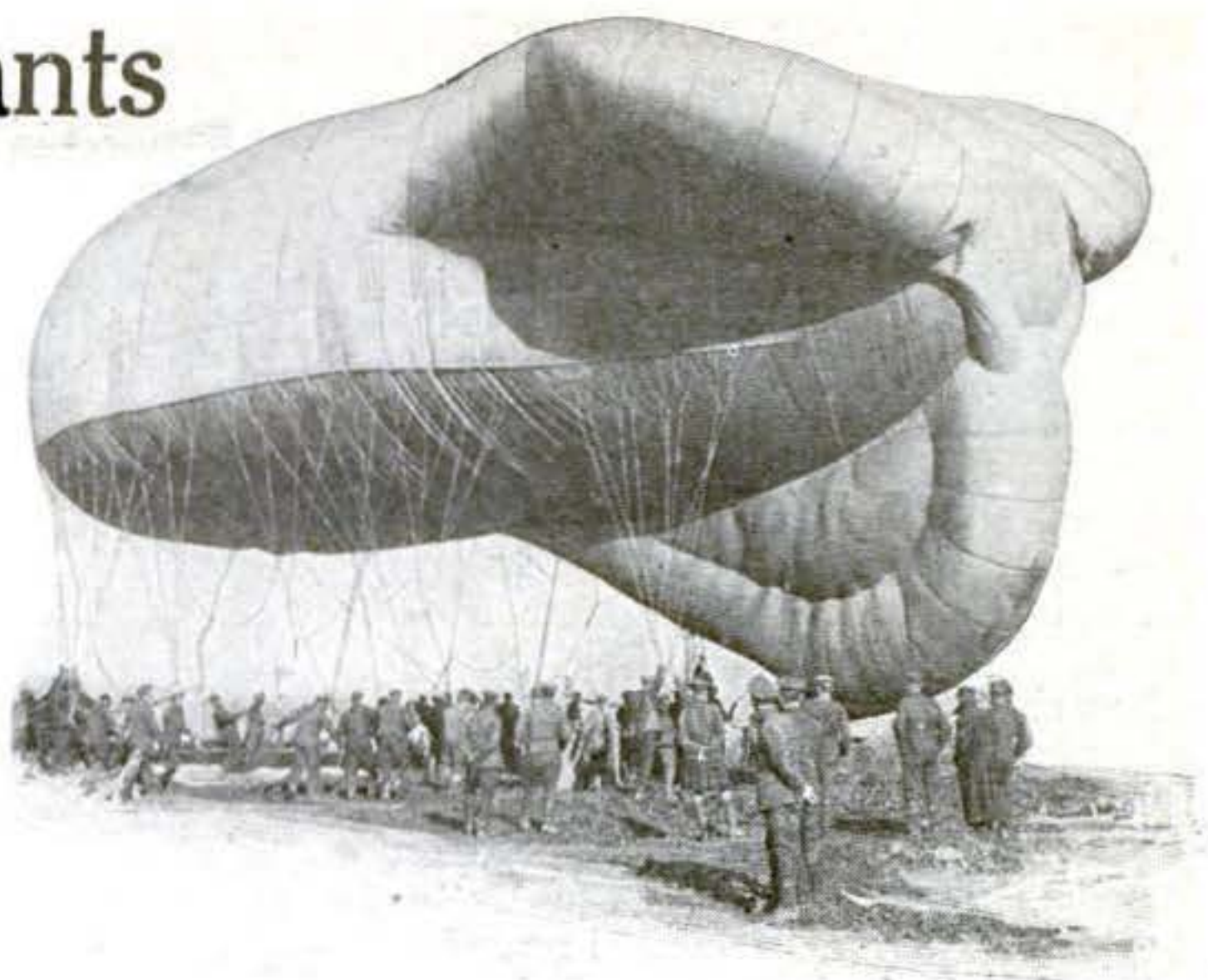
There are hundreds of such men as Debas in the balloon Corps of the Allies. No one ever hears of their calm courage, yet every one of them is inevitably a marked man. A single incendiary pellet in the twenty thousand cubic feet of highly inflammable gas that buoys him up, and he must leap for his life.

He has only a pitifully inadequate rifle with which to fight off an opponent who darts hither and thither with the unexpectedness and elusiveness of a gnat, and who is armed with a weapon that fires at the rate of six hundred bullets a minute. To escape death he must hook the harness that he wears to the parachute and step off into space.

Will the parachute open? He drops a sickening three hundred feet before the great umbrella spreads out with a report like that of a mainsail in the wind.

Why is the captive balloon used at all? Because

It was Captain Cacquot of the French army who improved the German sausage balloon and made an elephant of it. The bag that hangs below serves as a fin



it is in direct telephone communication with the batteries, and because it is so much steadier and roomier than an airplane that the enemy's positions can be minutely observed.

Unlike a dirigible, an observation balloon is not kept in a shed, inflated. It is stored, deflated, in a pit covered with camouflaged canvas. Just before an ascent, it is blown up with compressed hydrogen gas from steel bottles. It is prevented from rising during inflation by sand-bags. The height to which it may ascend is controlled by a cable paid out by a power-winch on a motor-truck. A telephone wire runs from the basket to the winch, and from the winch to "central."

The officer who is to go up straps on a harness that can be hooked in a

second to the parachute, adjusts a telephone headpiece to his ears, hangs his glasses around his neck, sees to it that the basket is properly equipped, takes his place, and gives the signal to "let go." Slowly the straw-yellow elephant-like mass floats up. When it reaches what seems to be the right height to the observer, the winch crew receives the order, "Hold."

Getting Started

First of all the observer calls up central. "Give me the chart-room," he says. From the chart-room the firing is controlled on the ground. He drops a plumb-line over the side, and notes the position of the balloon with reference to a spot directly below.

Then he says:

"I'm just over shed four of the aerodrome." That indicates his position.

"My height is 4000 feet." The chart-room can place him exactly on the map now.

"The wind is north-north-west, blowing twenty miles an hour." Wind means much in artillery fire.

"The reference point is the church spire of Sainte Marie." He might have used a wood, a cross-road, a farm-house.

"I'm ready when you are."

Now it is the battery-commander's turn:

"The time of flight of the shell will be twenty-two seconds." The observer notes it.

A howitzer roars. "Gun fired," telephones the commander. The observer watches.

"One degree and ten minutes right," he telephones down, meaning that the shot fell that much from the mark.

Is it any wonder that generals of all sides seek to bring down enemy balloons by dispatching airplanes against them?



When the balloon is fired by an incendiary bullet from an airplane, there is nothing for it but to jump

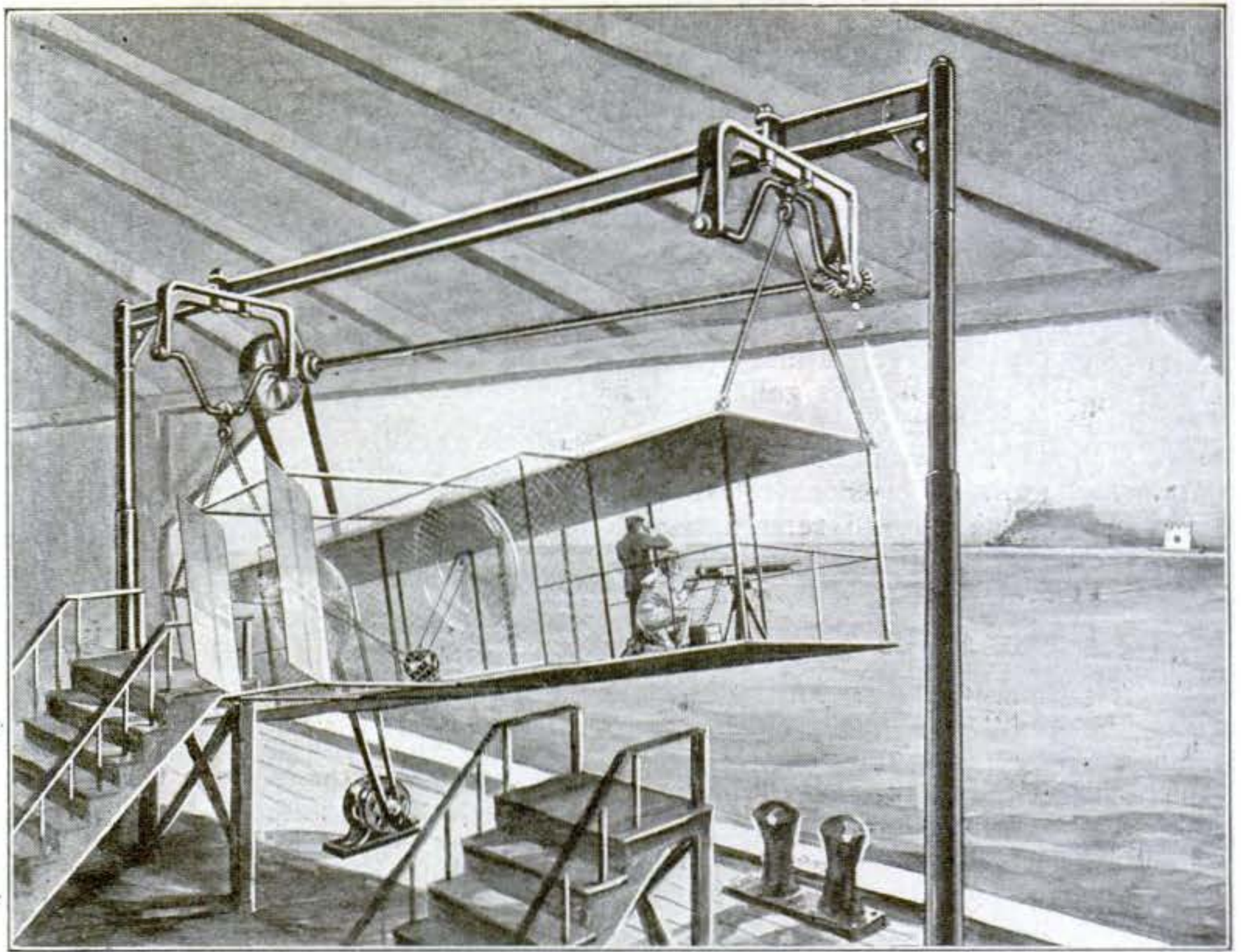
You Can Shoot Airplanes on Your Vacation

BELIEVING that variety is the spice of life, even in shooting galleries, and being heartily tired of the regular species, Mr. F. W. Thompson, of Atlantic City, has invented an airplane shooting gallery. This is arranged to give the shooters all the sensations of an aerial battle, except the quick fall through four miles of air after a hit.

The shooting platform is in the form of an airplane, and it is so constructed that it can be mechanically rocked from side to side. Two large propellers in the front, driven by an electric motor, send a breeze through the machine, which helps to heighten the effect.

The targets are also in the form of airplanes, and are suspended from an endless belt in such a manner that they can be knocked off by a bullet.

The track is undulating, so that an erratic motion is imparted to the miniature airplanes.



Here's a chance to learn to shoot accurately from an airplane in full flight, and without danger of falling through a few miles of space as a finish to the experience

BETWEEN Elmore and Clark's Gap, on the Virginia Railway, there is a stretch of road fourteen miles long with a grade of 2.07 per cent for the last eleven and one half miles. For the first two and one half miles the grade is 0.5 per cent. This stretch of fourteen miles of single-track road is a veritable neck in a bottle; over it must pass the entire traffic of the railway.

Even a short, steep grade materially reduces the hauling capacity of a locomotive. On a grade of more than one per cent, for example, a locomotive can haul approximately only one fourth as much tonnage as on an absolute level. Hence this heavy grade necessitates the use of a large number of pusher engines.

With these facts in mind, it is easy to understand why the Virginian Railway should have asked a Schenectady firm to build locomotives that

Three Times the Power of the Ordinary

can be handled by one engine crew, each having the hauling power of three ordinary eight-coupled locomotives. Ten enormous freight locomotives are now being delivered to the railway to meet the requirements.

These locomotives, which rank with the largest in the world, are of a type, known to locomotive engineers as "Mallet compounds." A. M. Mallet was a famous French designer who built the first true compound engines.

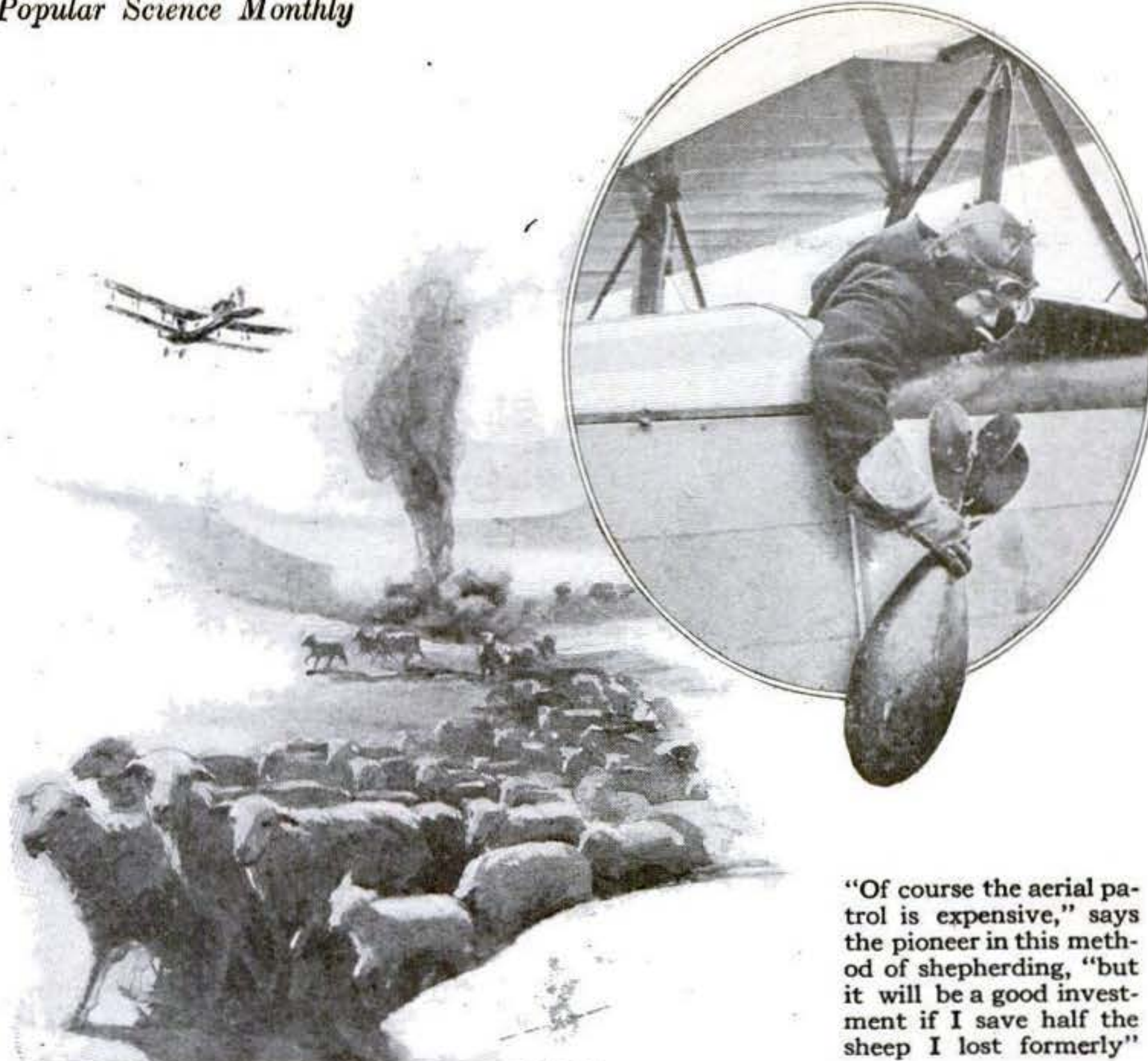
The maximum load a locomotive can draw depends primarily on the weight carried on the driving wheels. A locomotive must have adhesion; it must stick to the rails by sheer

weight if its wheels are not to slip. Just how this weight is to be distributed is always a nice problem. The locomotive that carries its entire weight, including that of fuel and water, on its driving wheels, can haul the heaviest train in proportion to its size. It is impossible to concentrate all the weight on a pair of driving wheels. The rails are not strong enough; nor are ordinary bridges. Hence the weight must be distributed over several more pairs of driving wheels.

Engines are classified according to the arrangement of their wheels. Numerals indicate the number of



Ten of these huge engines have been built to haul freight trains up a steep grade fourteen miles long on the Virginian Railway. The engine alone weighs 684,000 pounds; the tender, 214,300. Such weight may not be concentrated on a few pairs of driving wheels without crushing tracks.



Herding Sheep from a Flying-Machine

HERDING sheep from an airplane, signaling to herdsman and cowboys with smoke bombs and wireless, is the latest use for heavier-than-air flying-craft developed by J. Stanley Smith, a millionaire ranchman of Meagher County, Montana.

Mr. Smith studied aviation in Los Angeles.

"I lost about five thousand sheep last year," said Mr. Smith, "and all of this could have been prevented by the use of airplanes. Sheep, you know, always go in herds of several hundred each, and by wandering off into canyons and out-of-the-way places they are overlooked by the herdsman, to die later from exposure and starvation. It takes a man on horseback four days to ride from one side of my ranch to the other, but I can fly that distance in thirty minutes.

"By flying at an elevation of about a thousand feet I can observe every herd of sheep on the place. By dropping a smoke bomb I can point out lost sheep to my men."

"Of course the aerial patrol is expensive," says the pioneer in this method of shepherding, "but it will be a good investment if I save half the sheep I lost formerly"

Locomotive Is Concentrated in This Giant

wheels used (1) in the group of wheels supporting the leading end, (2) in the group of coupled wheels, and (3) in the group supporting the trailing end of the engine. Thus 4-4-2 represents a bogie engine with four coupled wheels and one pair of trailing wheels, and 4-4-0 an engine with four coupled wheels and a bogie. The standard heavy slow-speed freight engine of the United States is a 2-8-0, known as a "Consolidation." Then there is the "Decapod," a 2-10-0 used on heavy mountain grades.

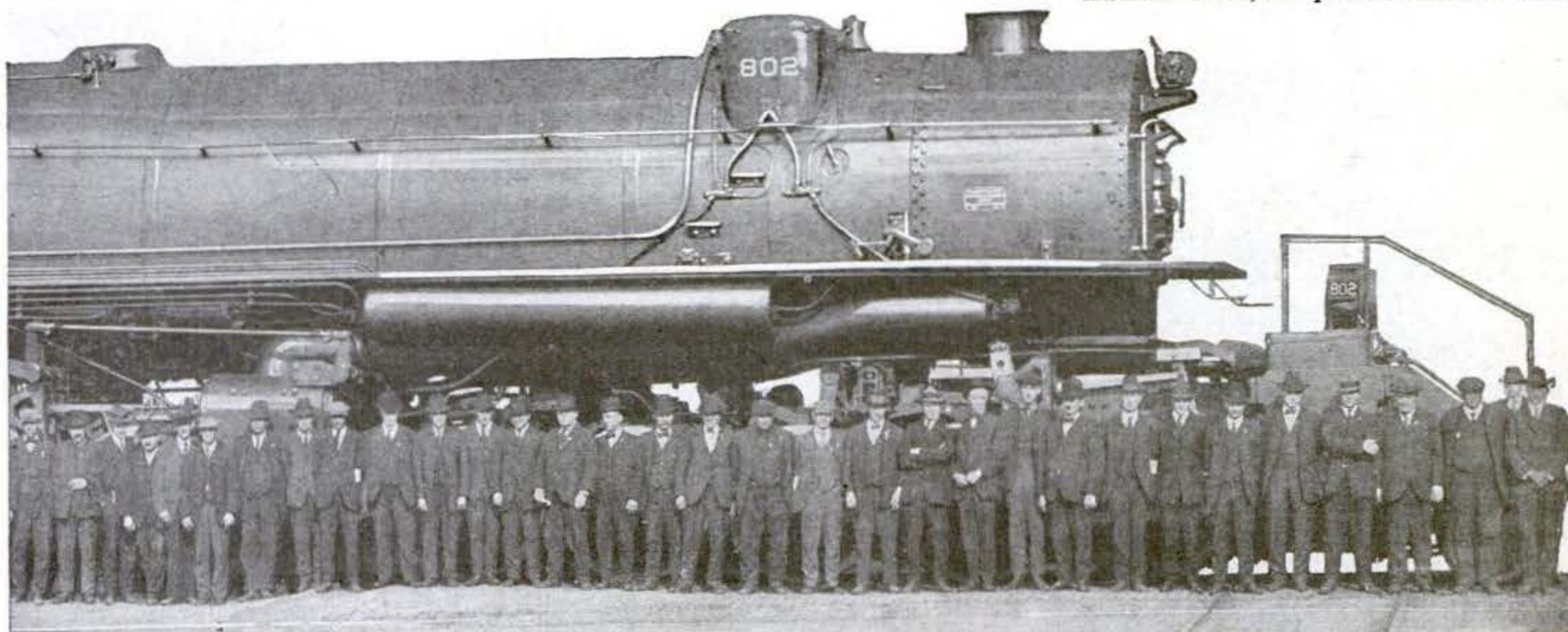
The ten wheels of the "Decapod" are coupled in a single rigid wheel base.

Suppose (and that is exactly what railway companies have demanded) that still bigger engines than the "Decapod" are wanted, how far can the distribution of weight be carried by increasing the number of driving wheels?

The locomotive designers found that they would have to divide the wheels into groups, carry them in separate frames, and provide the frames with joints so that sharp curves could be rounded. Do that and you have the Mallet compound, a picture of which stretches across these pages. Its numerical formula is 2-10-10-2.

What is the weight that must be so carefully distributed lest bridges and tracks collapse? For the engine, 684,000 pounds; for the tender, 214,300 pounds. Such a locomotive will haul on the level a loaded train one and a quarter miles long, weighing, exclusive of the locomotive, about 17,000 tons.

To fire such a giant among locomotives by hand is utterly beyond the capacities of even a superman; five tons of coal are burning in the firebox at a time. So a mechanical stoker must shovel the fuel. The grates, too, are shaken, not by hand, but by mechanism. Even the reversing of the engine is too much for feeble human arms; air-power must be used.



Hence the weight has to be distributed on two sets of drivers, comprising ten wheels each. To fire this enormous locomotive by hand is too much even for a superman; it eats up coal too fast. A mechanical stoker is installed which does the shoveling for the fireman.

Hunting the Submarine by Wireless

THE photograph below shows a British armored cruiser at work clearing the North Sea of enemy vessels. The star-shaped spreaders are the end-supports of two wire "cages" forming part of the wireless antenna. In addition to the usual aerial wires running from peak to peak of the ship's masts, cylindrical groups of six or eight similar wires are frequently extended from the mast-tops, and hauled out as nearly horizontal as is possible by means of ropes from bow and stern.

These "cages" are sometimes a hundred feet long. The wires forming them are held some eight or ten feet apart by the spreader "stars" located every thirty or forty feet along them. By the use of these additional wires the electrical capacity of the radio aerial system is increased.

It requires not only a well planned organization including many ships, seaplanes, and observation stations to cover such large area, but also a rapid and reliable method of communicating between them. For this purpose the submarine sound signals, heliograph and search-light "blinkers," and radio (or wireless) telegraphy are used.

Only with almost perfect signaling systems could the fleet carry through such successful strategic operations as the raids on Zeebrugge and Ostend.



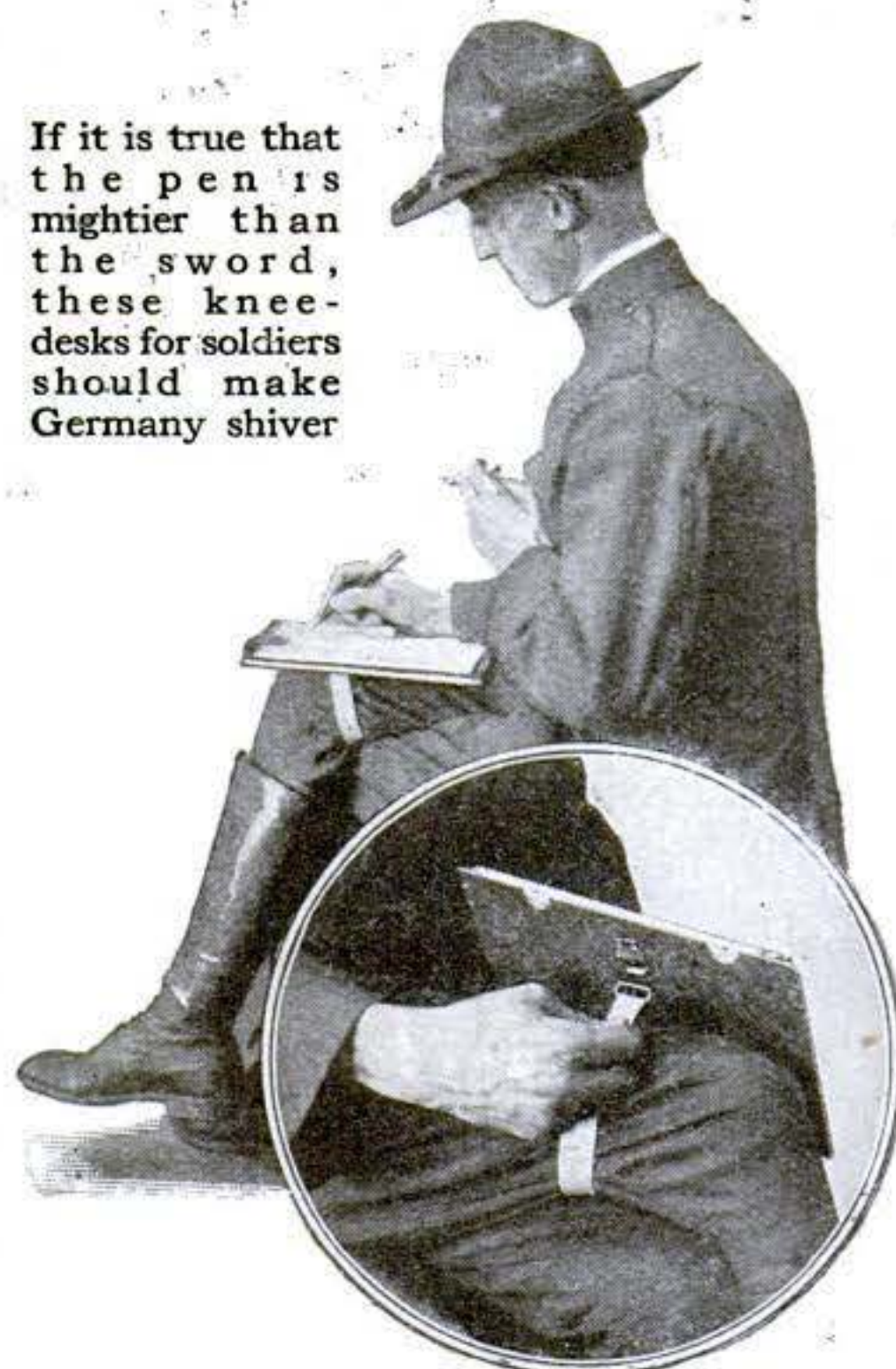
Not even the weight of this husky young man can disturb properly sewn seams

The Winds Can't Possibly Tatter This Flag

ASIDE from the muscular development of the young man chinning himself in a unique fashion, the most important feature of this illustration is a system of sewing. The flag, one of twenty-seven used in the International Code, is made up of oblique red and yellow stripes, and stands for the letter "Y."

Any flag aboard ship is played with so vigorously by the winds that it soon becomes tattered and torn if not made properly. Oblique stripes present the most difficult problem. To strengthen oblique striped flags, the colors are cut and put together in such a manner that the thread will parallel the direction of the pull.

If it is true that the pen is mightier than the sword, these knee-desks for soldiers should make Germany shiver



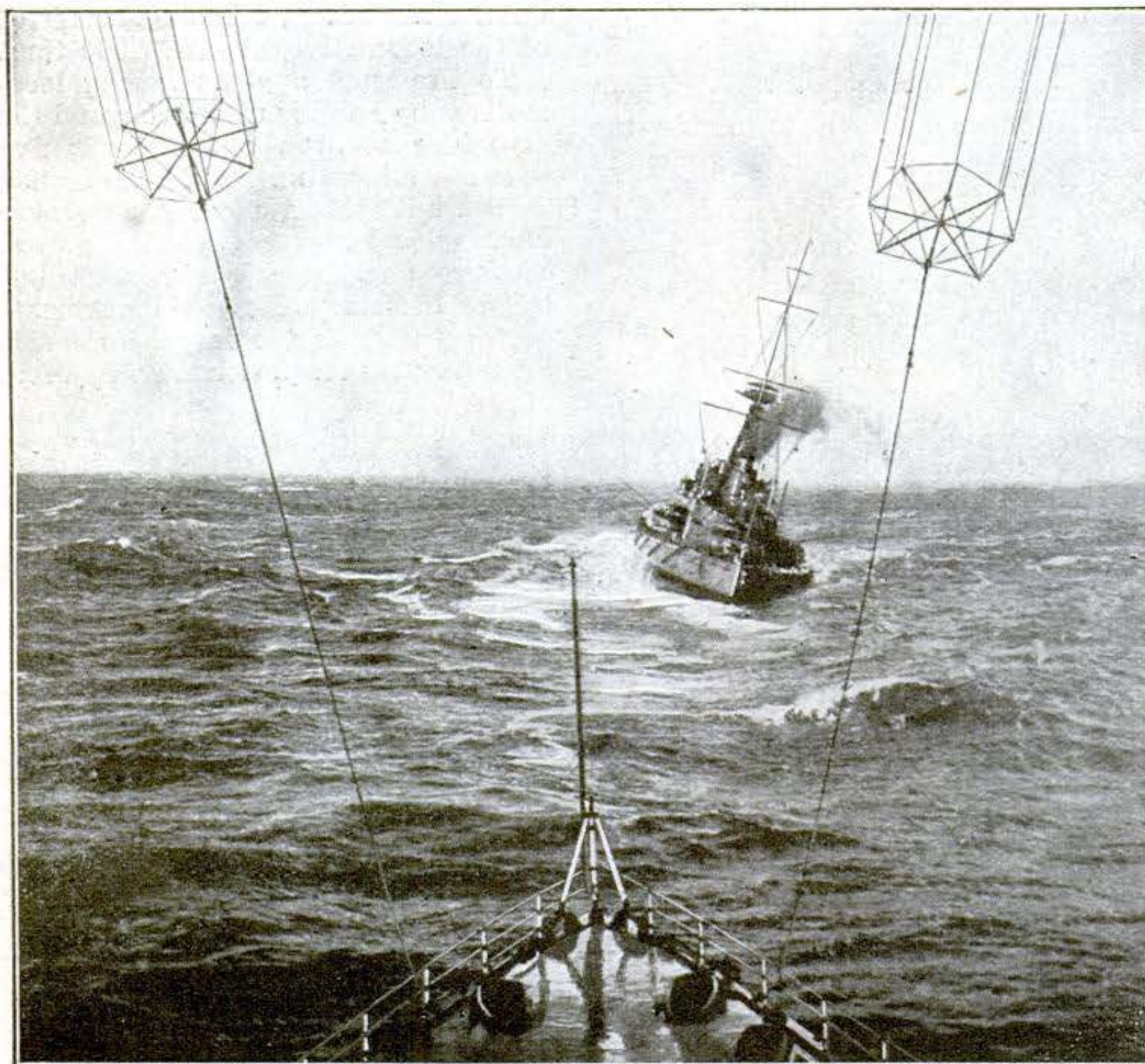
A Rapid-Fire Writing-Desk for Soldiers

FAIR warning to the censor:

Increase your office force at once or get swamped. The reason appears in the latest bit of field equipment for our fighting forces—a writing-desk that fastens firmly to the leg with an elastic band.

Provided with this desk, the soldier has no excuse for not keeping up his correspondence, as may be seen by this description furnished by the makers:

The desk is instantly adjusted to correct writing position, no matter whether you are sitting on a cot, on the ground, or standing with your foot on the fire-step, on a log, or a fence rail. One sheet of paper at a time is removed from the desk pocket and slid under a close-fitting nicked clip. There is even a candle in a brass holder to enable the soldier to write at night.



A British armored cruiser with wireless equipment, hunting enemy vessels in the North Sea. The stars are spreaders for the wires that form part of the wireless antenna

Why Caviar Costs So Much



Drawing the seine at a sturgeon fishery on one of the Russian inland seas

THAT caviar has been known for centuries as a table delicacy is shown by Shakespeare's reference to it in "Hamlet." It is prepared, as a rule, from the roe of different species of the sturgeon. The best caviar comes from Russia. The great Russian rivers and seas are centers of large sturgeon fisheries.

The sturgeon is a long-bodied fish with five rows of bony shields running lengthwise in its body. The fish vary in length from about a foot up to twenty-four feet, and the weight may be as much as a ton. It was considered an even greater delicacy in antiquity than it is now. In England and France, in medieval times, every sturgeon caught belonged by right to the rulers.

The most valuable part of the sturgeon at the present day is the roe. The best roes come from the sterlet, a small Russian sturgeon; the largest eggs from the great white sturgeon, called in Russia the *beluga*, which is one of the biggest Russian species. A white sturgeon, weighing two thousand pounds will have a roe weighing over two hundred pounds — a small fortune for the lucky fishermen.

The best caviar, called in Russia *ikra*, is made by rubbing the eggs through a hair sieve, either with the hand or by beating them



Ikra, the best caviar, is made by rubbing the eggs through a hair sieve

with switches. This straining through the sieve frees the eggs from the fatty matter and fibers. Thus cleansed, the eggs are mixed with from four to six per cent of fine salt, and form an almost liquid variety of caviar. The larger the grains, the more fluid in substance, the fresher and less salted

They net small sturgeon, but the 2,000-pounders are taken with hook and line

the *ikra*, the more highly it is prized. It is difficult to preserve and is made only in winter.

Pressed caviar is the ordinary kind. To make this the roes are covered in wooden troughs with a brine and packed in linen bags. The brine is then squeezed out in a wooden press. The pressed eggs are packed in small casks lined with linen. Pressed caviar forms from six to seven eighths of the entire Russian production, the remaining eighth consisting of the more liquid varieties. The substance remaining in the hair sieves after the fine quality of caviar is rubbed through is an important article of food of the native population. Astrakhan is the great market for genuine caviar.

The chief constituents of caviar are albumen and fat. It is, therefore, easily digested and nourishing. Additional ingredients spoil the delicate flavor of good caviar.

Because of the demand for caviar, numerous imitations have appeared. There is what is called red caviar, which is made from the roes of pike and carp.

Along the Mediterranean red caviar is made from the tunny and the mullet. Norwegians salt the roe of cod. In the United States caviar is made in the fisheries on the Mississippi and the Great Lakes.



Taking out the sturgeon roe from which caviar is made. In Russia women did their part in the fish factories long before the day of war work

Faking the Supernatural

How spiritualistic frauds are perpetrated

By Hereward Carrington



The "medium's" properties are hidden in various secret places—a hollow chair-seat, the curtains, in the inevitable mandolin



He places the white robe in a black bag. Then he puts on a pair of black gloves, invisible in the darkness



Gradually he shakes the white stuff loose, and it appears to grow. When it is well up he darts out and throws it robe-like around his own shoulders



Suddenly a form appears clad in snow-white robes, a turban on its head, with flowing beard and hair

A DOZEN awed spectators are gathered around the cabinet of the medium. The medium and cabinet are searched. Nothing suspicious is found. The room is darkened. On the carpet, two feet or more in front of the cabinet curtains, a white spot appears. It increases in size, turns and twists and writhes as if it were a thing in agony. It turns and tumbles, and grows larger and larger, before the eyes of the spectators.

Finally the thing assumes the size of a person. A head and face now appear. "Lights" are called for. There, standing before the bewildered spectators, is a form—clad from head to foot in snow-white robes, a turban on its head, with flowing black hair.

The lights are turned down; the "spirit" begins to melt; it turns and twists again, dwindles and dwindles, until at last nothing but a white spot is seen upon the floor. The lights are turned up. The medium is found in a deep trance within the cabinet. No sign of the spirit is seen. No explanation of the miracle is forthcoming!

Have we seen a genuine "spirit materialization"?

I am not now attacking spiritualism in any way. My sole object here is to expose an old form of fraud in the interest of honest spiritualists as well as of the public. Most materialistic manifestations of the kind here described are faked. The forms are so crudely produced that it is hard to believe that even willing believers are fooled.

The hair, turban, and white material are hidden in various secret places—a hollow seat in the chair, the cabinet curtains, a hollow boot-heel, a dummy watch, in the mandolin inevitably used for the "physical manifestations," etc.

Under cover of the darkness, the medium extracts these various articles, dons the beard, hair, and turban, and places the long white robe in a black bag, which he has also hidden. He also puts on a pair of black gloves.

Lying on the floor well behind the cabinet curtains, he stretches out his hand. The gloved hand holds the bag containing the white stuff. Gradually he works and shakes this loose. It appears to build itself up and grow. Then he works it upward. When it is well up, he darts out from behind the cabinet curtains, throws it about his own shoulders, and calls for "lights."

The reverse process is similarly executed. The medium creeps back into the cabinet, lets the robe gradually sink to the floor, tucks it into the bag, and whips it behind the curtains. He then replaces the various articles in their hiding-places, and calls for lights and an investigation. Nothing is found except the medium.



Italian Official Photograph; © Underwood and Underwood

It was the mining engineer who first used wire-rope railways to connect mountain-peaks. Now the Italians use rope railways to carry their wounded

Caring for the Wounded Amid Mountain-Peaks

THE fighting line on the Austro-Italian front extends from the Alps to the sea, and much of it lies in the mountains. Some of the peaks reach a height of six thousand feet or more, and many a battery is mounted above the vegetation line.

Nothing but rocks everywhere, covered with snow and ice the greater part of the year—rocks that may, in some cases, protect the fighters against bullets and shells. But the men cannot always remain behind the sheltering rocks. When they crawl out into the open, they are unprotected. Digging-in, the usual method of providing shelter, is out of the question.

To protect the wounded men and the surgeons and nurses at the first-aid stations on or behind the fighting line in the mountains, shelters are constructed in protected places. The walls are built of rocks and sand-bags, the roofs of heavy timber covered with sand-bags. The picture above shows one of the Italian first-aid stations in the mountains between the Brenta and the Piave.

When Our "Fighting Wild-cats" Begin to Shoot

THE thrill that chases up and down your spine every time you see a platoon of our boys go swinging by is backed up by some real, honest-to-goodness figures.

Our doughboy goes over the top with a hundred more nickel-coated conversational tablets than any debater across the way—one hundred more rounds of ammunition in his belt than

the German soldier.

American soldiers carry 220 cartridges in their handy web-belts and bandoleers; the German infantryman carries 120 rounds. With the modified Enfield, the new service arm, the American doughboy can deliver twelve shots a minute for eighteen minutes.



© Underwood & Underwood

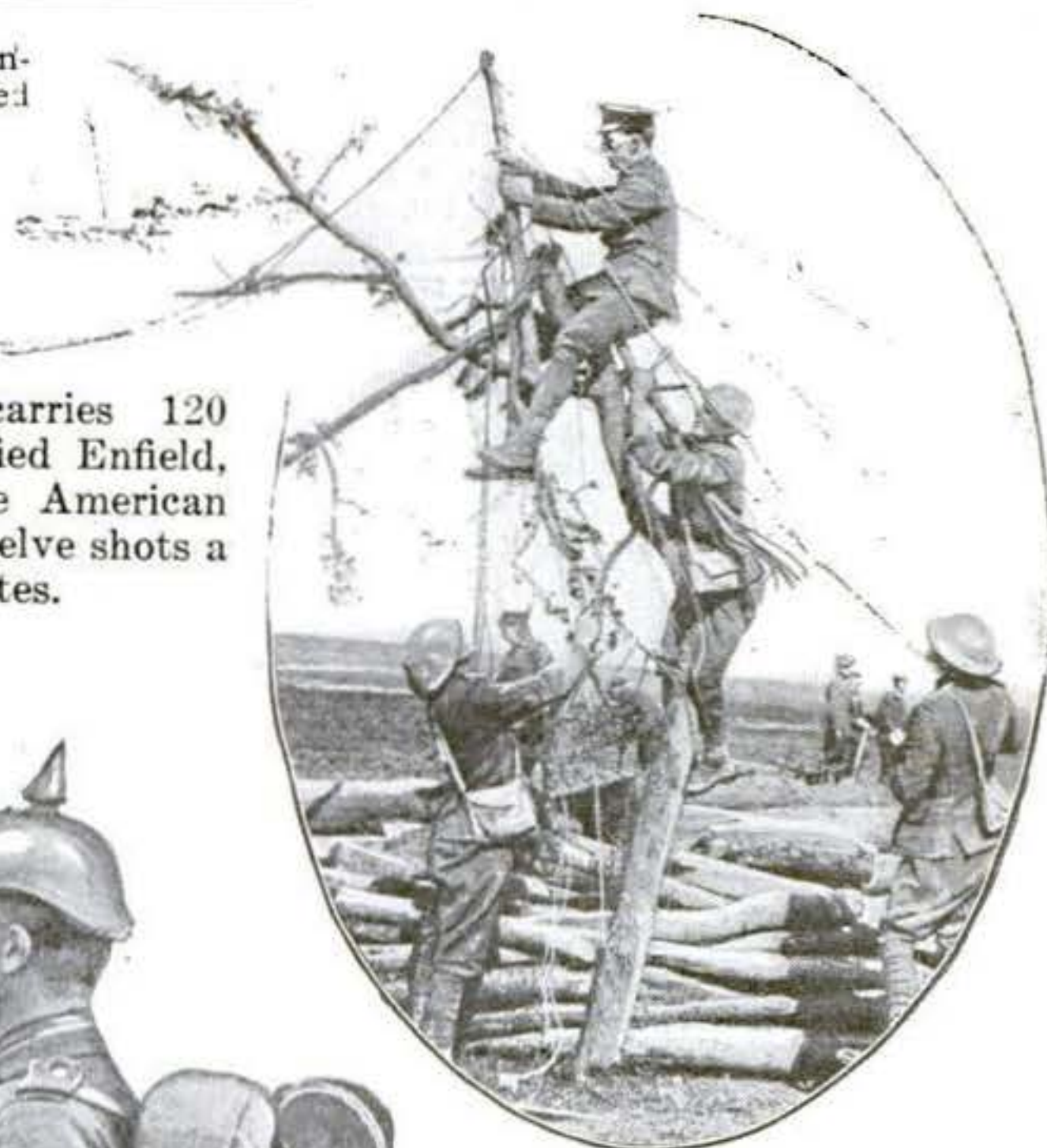
Radioing the Message to Garcia

RADIO-TELEGRAPHY has two particular uses in the army: to supplement the field telegraph and telephone lines, and to receive communications from artillery observers in airplanes.

In the former service, as soon as new territory is captured temporary wireless stations are erected for communicating with field headquarters until the usual telegraph and telephone lines can be established.

Trench wireless stations are generally discontinued when the gain has been consolidated, to use the military term.

In airplane service, the command-



Canadian signal corps men erecting an umbrella-type aerial in a tree almost abandoned by its leaves

ing officer of an artillery unit far behind the lines receives information by radio from observers in reglage airplanes which fly constantly across enemy territory.

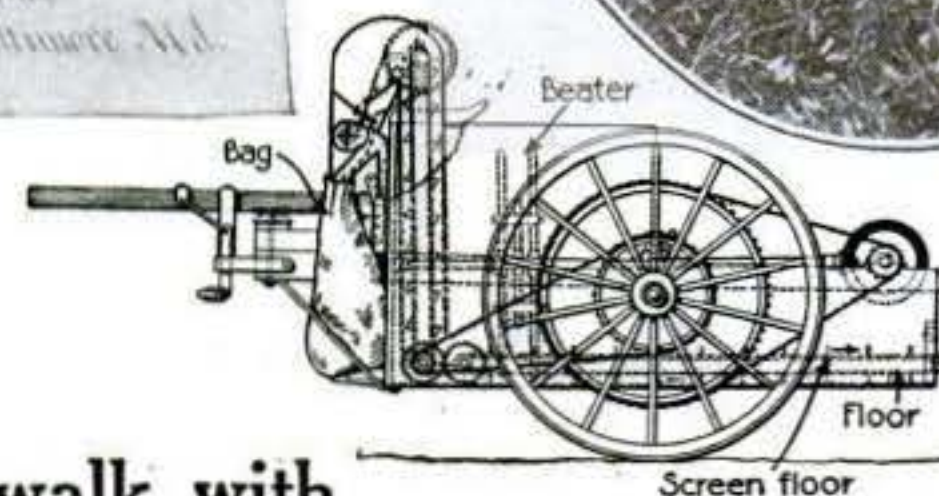
The front is blocked off in checkerboard fashion, each block, or square, being given a distinguishing code word or number.

The job of the artillery observer in the reglage airplane is to spot enemy artillery, ammunition trains, masses of infantry, etc., which should be bombarded.

He wireesses the code number of the square to the artillery commander, and then sits up near a cloud to watch results, and to correct the "spotting shots" by means of wireless until the exact aim desired has been achieved.



Stuart's famous portrait of Washington, of which his adopted son, in "Recollections and Private Memoirs of Washington," says: "Washington, at the time Stuart painted his portrait, had a set of ivory teeth that were too large and clumsy. Stuart's mouth is a caricature"



The Pritchard harvester—one of several machines invented by North Carolina farmers for gathering the soy-bean crop from the growing stalk

Washington's False Teeth and His Expression

GEORGE WASHINGTON suffered from defective teeth. Before he was thirty he had frequent toothaches. One by one he had his teeth drawn. Eventually he had to use artificial teeth—according to some biographers, as early as 1789.

It seems that Washington's false teeth were of rather primitive and imperfect workmanship, and fitted so badly that they caused a distortion of the mouth and a consequent change of the lower part of the features.

When Stuart painted Washington's famous picture, says P. L. Ford in his book, "The True George Washington," he tried to remedy the malformation the artificial teeth had given to Washington's mouth, by padding under the lips with cotton. The same biographer chronicles that in 1796 Washington was furnished with two sets of "sea-horse" (ivory) teeth, and these were much better fitted.

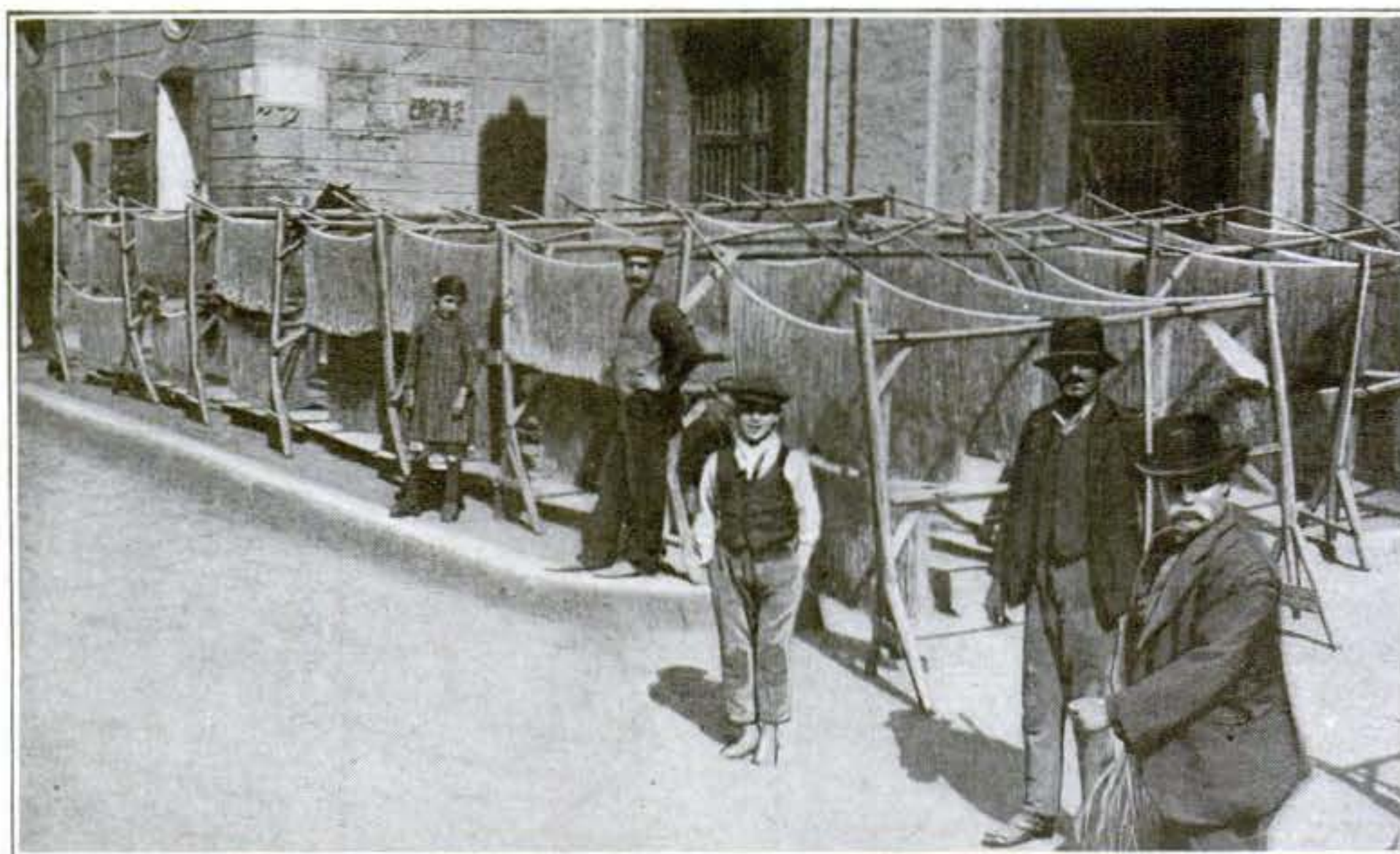
The double set of ivory-carved teeth shown in the picture was one of the sets that a New York dentist, Dr. Greenwood, made for President Washington.

Blocking the Sidewalk with Drying Spaghetti

ONLY those who have traveled in Italy realize the extent of the macaroni and spaghetti industry in that country. Everywhere are spaghetti factories.

The smaller factories carry on their work in limited and by no means immaculately clean quarters. Lacking sufficient space indoors for drying their products, the proprietor boldly appropriates the sidewalks.

They set up trestles with poles across the tops, and upon these they hang the macaroni and spaghetti to let them dry in the sun. Scenes like that shown in the illustration are common throughout Italy, and no one seems to object to the blocking of the sidewalks by noodles.



A common street scene in Italy. Nobody seems to object to the spaghetti manufacturers' custom of drying their product on the sidewalks

How North Carolina's Soy Beans Are Harvested

THE production of soy beans in North Carolina exceeds a million bushels a year. To harvest the crop special machines have been invented by the farmers themselves.

The harvesters thresh the beans from the vines as they stand in the field. Five types of harvesters are made by farmers in North Carolina, but a beater with fingers is common to all the machines. The beater gathers the beans from the growing stalks. Its operation varies according to the type of harvester. Some beaters revolve parallel to the row; others at right angles to the row. Some harvesters are carried on mowing-machine wheels and others on common cart-wheels. In some the beaters are driven by chains; in others by gears.

L. S. Gordon, a farmer of Elizabeth City, invented the first one. Another successful harvester is the invention of Herman Hardy, of Lagrange.

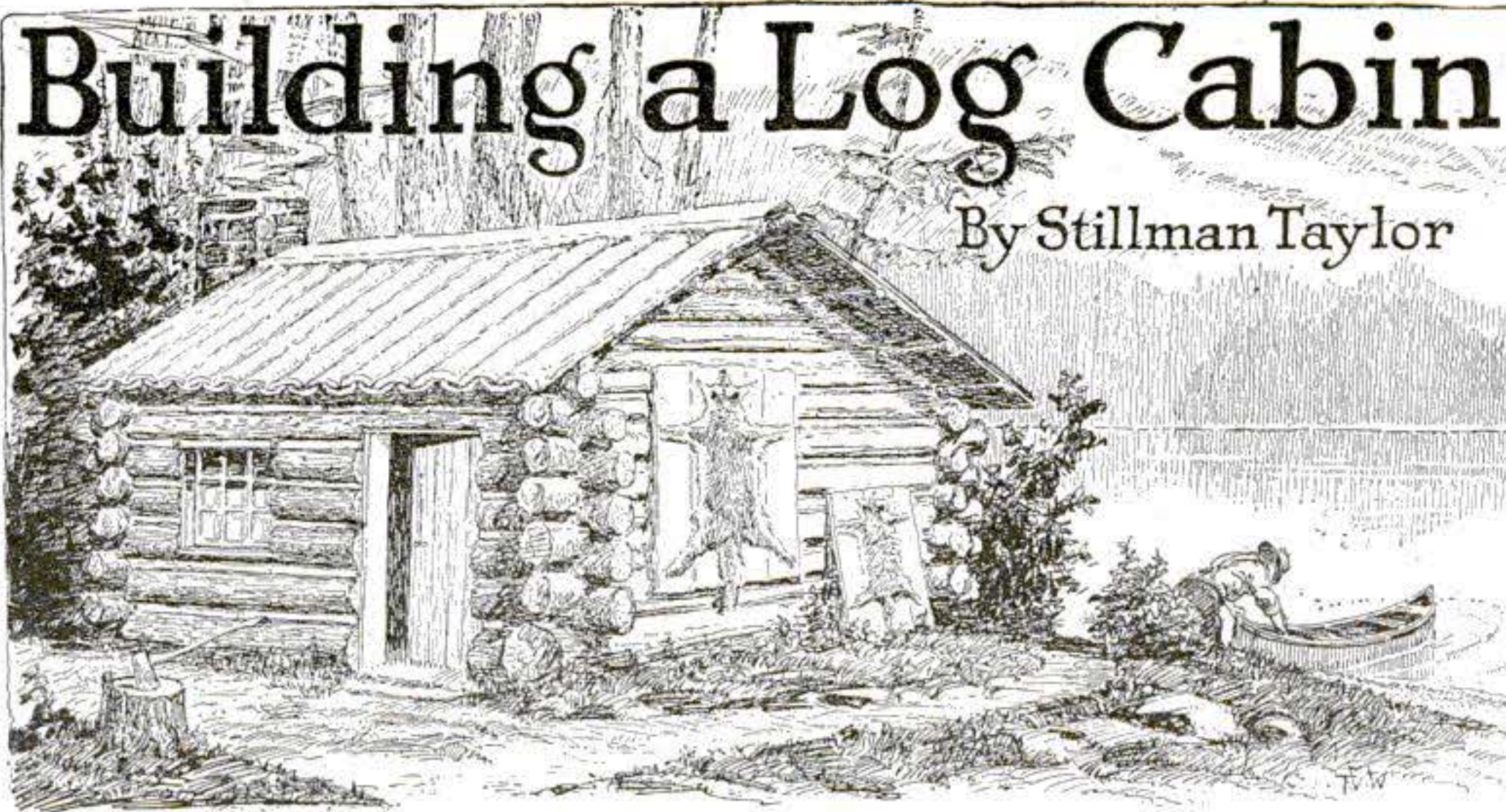
George E. Pritchard, of Elizabeth City, invented a complicated but very efficient mechanism.

FOR the building site, pick out some sheltered spot on slightly elevated ground, with good drinking water and plenty of straight timber close at hand. For material, spruce, pine, and hemlock are the favorites, but any wood may be used. The hard woods, however, ash, oak, etc., are heavy to handle when green. When felling your timber, pick out trees as straight as possible, of uniform diameter. Logs of any size may be used, but the diameter should be in proportion to the size of the cabin. For the average size cabin, logs about 8 in. in diameter are the best.

The logs should be not less than 2 ft. longer than the inside dimensions of the cabin, to allow for the lock joint at the corners. A 10-by-12-ft. cabin will afford comfortable quarters for two,

Building a Log Cabin

By Stillman Taylor



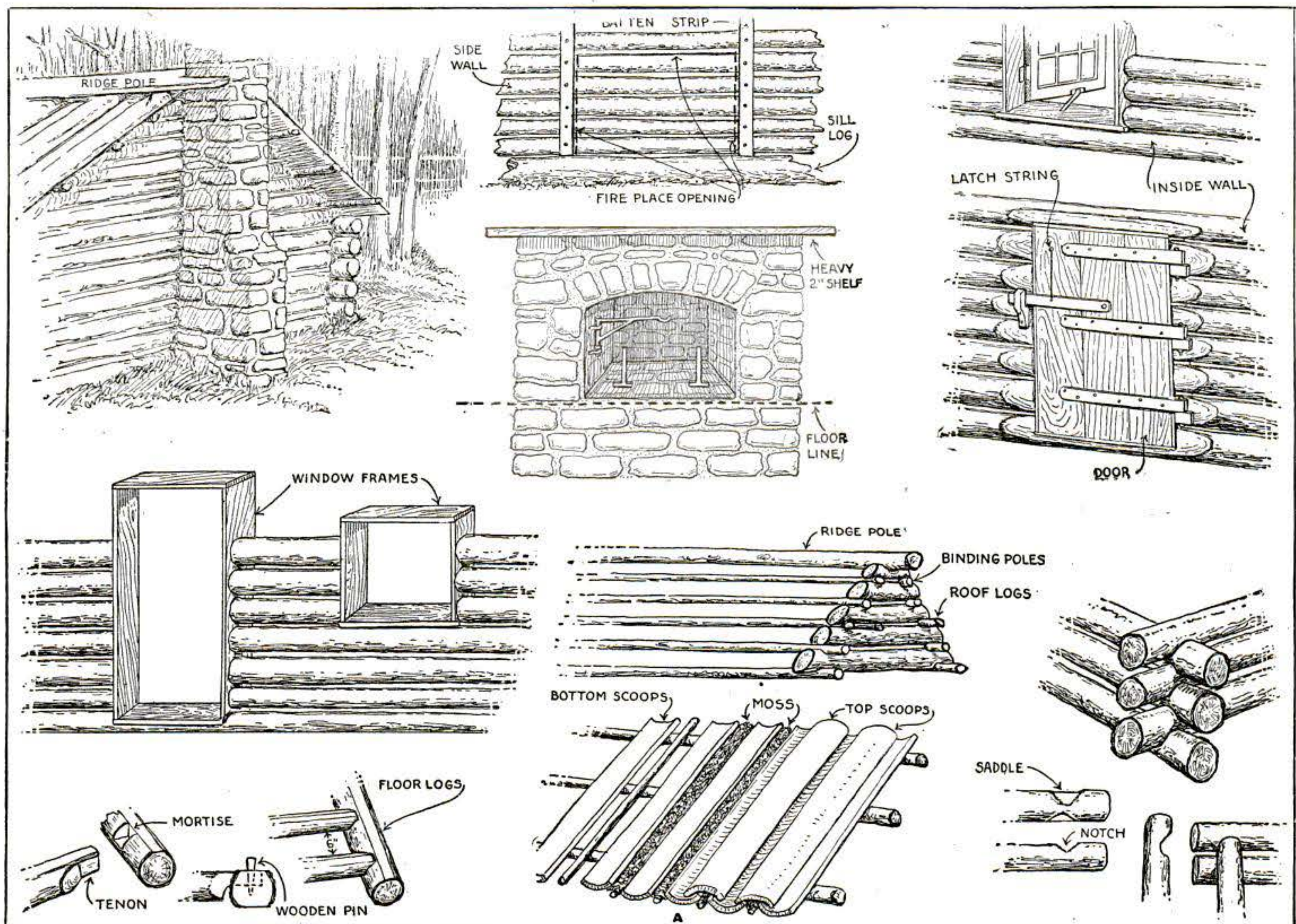
and a 12 by 16-ft. house makes a very commodious home in the woods. As the method of construction is the same, any desired size may be constructed from the illustrations. By building two separate cabins, about 8 ft. apart and roofing over the whole, a double cabin, known as the "saddle-bag house," may be erected. Doors and windows may be made of a suitable size.

For the side walls of a 10-by-12-ft. cabin, 36 logs 8 in. in diameter will be

required. Half of these should be 14 ft. and the others 12 ft. in length. This will build a wall about 6 ft. high, which may be increased if wanted.

All the building material may be hewn from the log, but a better finish and much labor will be saved by taking along enough boards for making the door, windows, door-frames, and the floor. The bookcase, gun cabinet, cupboard, etc., may be fashioned from packing boxes.

Begin the cabin by staking out its length and width, and leveling off the ground. It may rest on the ground, but it is better to sink supporting posts about 3 ft. deep, with the tops sawed off level, about 6 in. from the earth. Place a post at each corner and one in the center of each bottom log.



The chimney outside of the building is constructed of cobblestones as well as the fireplace within, the connection being made through an opening in the logs. Details of the door, windows and window-frames, roof and corners are also here shown.

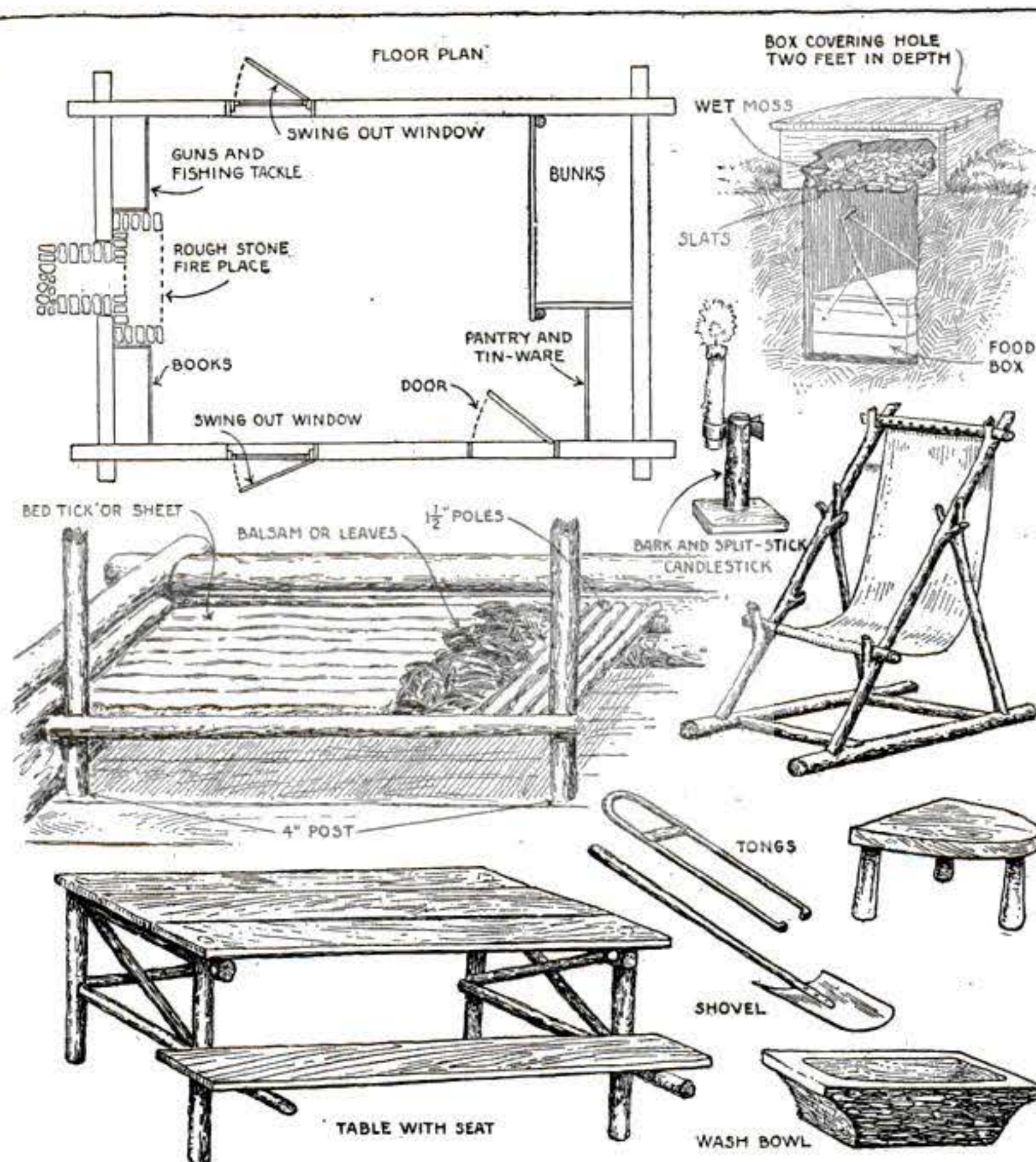
The logs are notched as shown to form the walls. To keep the walls level, use logs of nearly the same diameter, or if some are tapering, reverse the butts to even up the building line.

Openings for the door and windows are easily made as the work proceeds. The logs are cut off square to butt snugly against the frames, and nailed solidly. The frames may be hewn from logs, or boards may be used. To avoid difficulty in getting special sized sashes, it is a good plan to buy the windows and make the frames to fit them while building the walls. The sills should slope outwards to shed water.

When the side walls are 6 or 6½ ft. high the end gables are laid. A fairly high-pitched roof will prove more weather-tight. By running poles across, a loft may be built in which to store away skins and camp duff. For the roof, boards may be used, or the trough roof shown at A, page 85, may be constructed. For the scoops, pick out a few trees of the right length and split them through the center. Hollow them out by cutting a series of notches on the flat side, and then cut out the wood between the notches.

The chimney should be built at this stage. Construct this of rough stone and cement, building it up on the outside of the end wall. The foundation for it should be 2 ft. in the ground. A flat stone will serve for the lintel, or you can arch it over by making a wood form to serve as a mold. The fire crane is of stiff iron, fitting into sockets which act as hinges. Embed the sockets in the stonework while the cement is soft. The important thing to remember is to provide a large smoke flue, not less than 14 in. square with a deep throat to give the smoke an easy start. Extend top of chimney well above the ridge pole to secure a good draft. Pieces of tin roofing sheets, or sheets cut from large tin cans, may be used to flash around the chimney. Insert the edge of sheet between the stones. While the cement is soft, bend it down and let the end project under the ridge pole. Overlap each sheet, and the roof will shed water.

A tamped earth floor is often used. A rough wooden floor may be laid by smoothing the tops of the logs, but a board floor is best. Any cheap lumber will serve. In the illustration details are given for fitting the floor joists to receive a board floor. A good sub-



Floor plan and outside cellar for food, bunks, and camp furniture, all constructed of material found about a camp

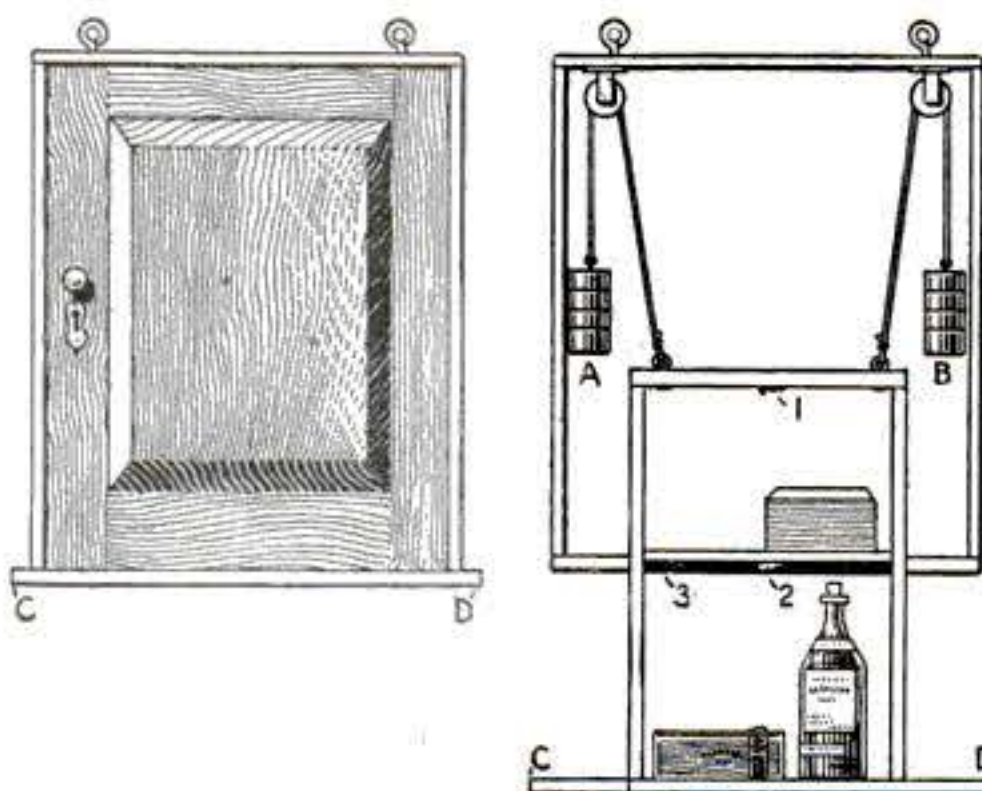
stantial door may be made and hung on by iron hinges. The door should be hung to open inside.

Single sash windows are best, and should be hinged to swing outwards. A wooden strut may be added to keep the sash open to any desired angle, and a hook and eye will fasten it securely.

Bunks may be constructed double, one berth over the other. Camp furniture may be constructed from boxes and odds and ends of lumber. A few useful devices of rustic form are shown.

Secret Entrance to the Shelves of a Cupboard

FROM all appearances the cupboard described in this article is not out of the ordinary, but the keyhole and knob are only for show, as the contents are reached by a secret sliding



The door of this cupboard is a sham; the shelves are dropped through the bottom

frame with shelves. It is only necessary to pull down on the projecting ends of the base (at C and D), which is the lower part of the frame.

The diagram shows how the working parts are made. The frame holding the shelves enters through an inside base at the number 3 and is hung on two cords run over pulleys. Counter-weights A and B are attached to keep the shelves within the case. At the numbers 1 and 2 turn buttons are placed to hold shelves in position. The case may be made in any size to suit the requirements of those using it.—JAMES E. NOBLE.

Making a Good Soap from Scraps of Fat

ARE you trying to conserve fats? Then you know that one way to conserve is to use up the scraps of fat in making soap. If you have

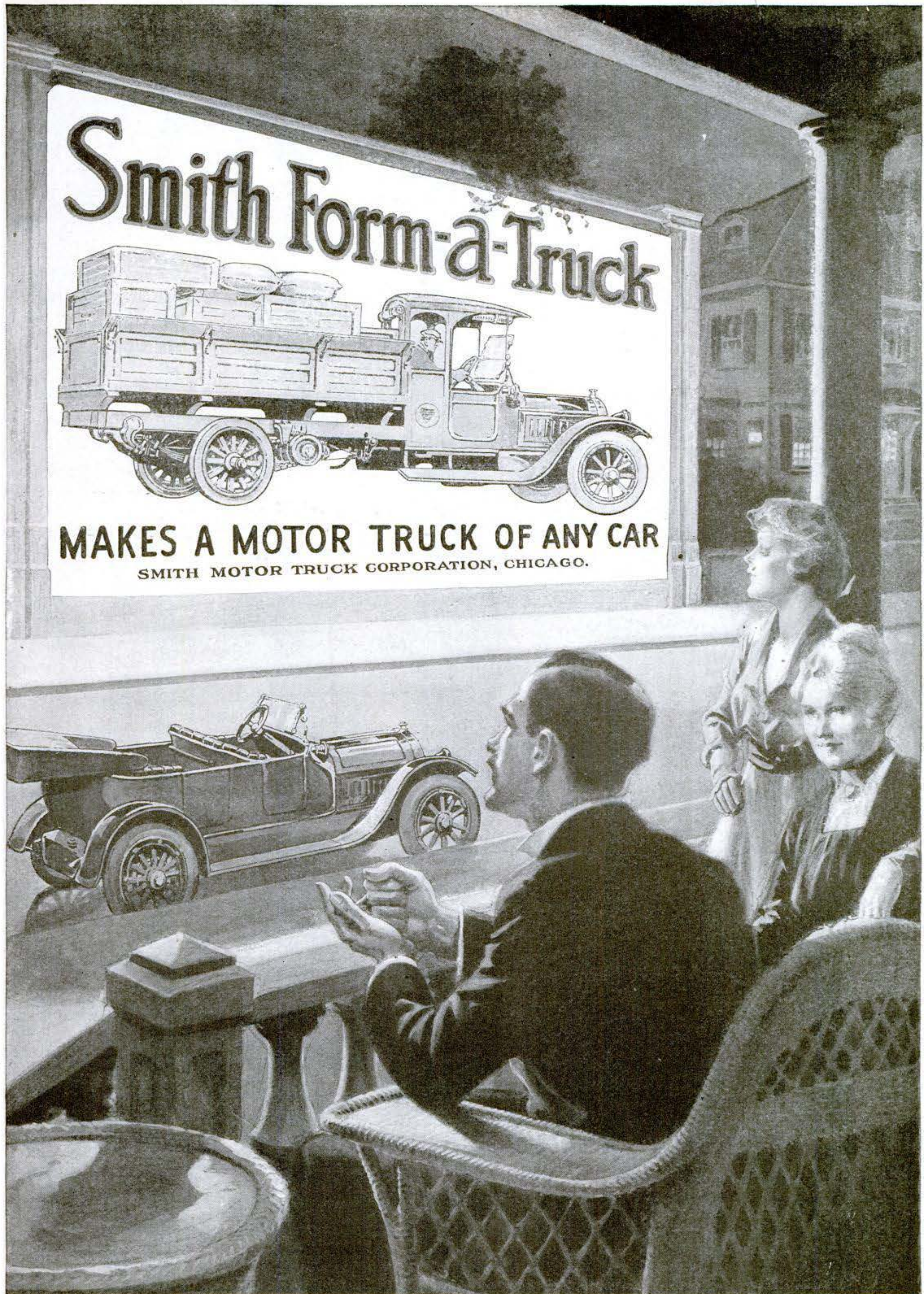
tried to follow the direction on a can of lye, you were appalled to find that it was necessary to accumulate 5½ lbs. of fat. Perhaps, after carefully following the directions, instead of ending with something you could call soap you still had a greasy, curdled, useless mess.

Do not be discouraged. Next time you make soap observe these precautions. Have the fat only just melted. Add the lye very slowly. Make the soap in small quantities at first, anyway.

Pour into a fruit jar 5¼ cups of cold water. Add to the water the contents of a can of lye. Stir until all the lye is dissolved, and allow it to become completely cold.

Try out the fat from scraps of meat by heating. Clarify the fat and get any salt it may contain by boiling it for at least five minutes in several times its volume of water. Allow the fat to collect, then skim it off. It may be melted and strained again.

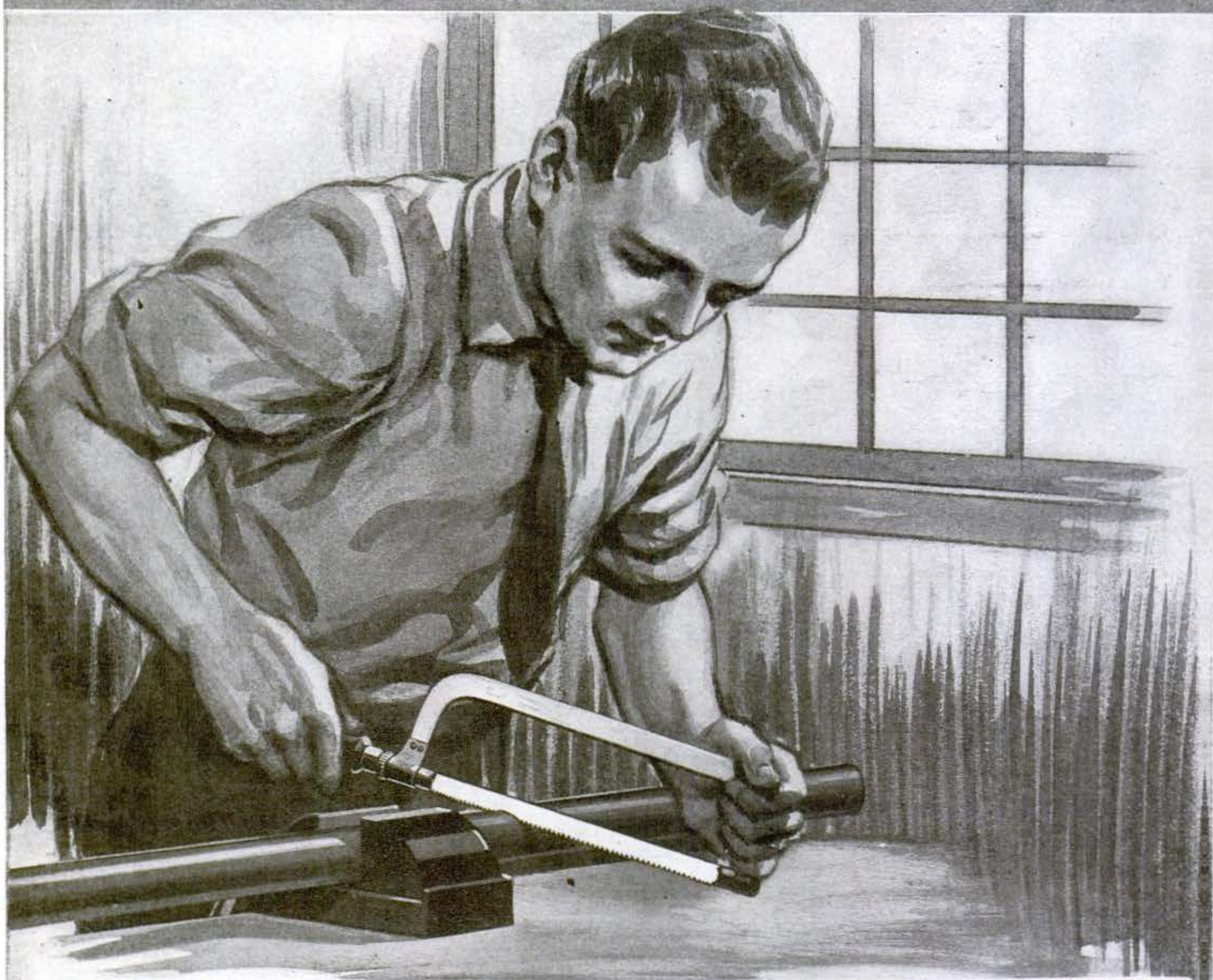
Make out of stiff paper or cardboard some molds about the shape of a cake of laundry soap, but thicker. Weigh out ½ lb. of fat. Heat it just enough to melt it—no more. Measure out ½ cupful of the lye solution. Add the lye to the fat a spoonful at a time, stirring well after each addition. This should not take over five minutes. Keep on heating until the mass is fairly thick, then pour it into molds. Set it away to harden and ripen, and you will be enthusiastic when you use your fine floating soap for dish-washing.



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GOODSELL-PRATT Hack - Saw Blades have fast-cutting qualities and long life. They are made of the best possible material. Extreme care is used in tempering.

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Our G brand blades are the best that it is possible to manufacture. They are made of a special high grade of hot rolled sheet steel .025 inch thick, cut so that the length of the blade runs with the grain. The teeth are formed, sharpened, and set by our own special process on automatic machines. These blades are unequalled for speed and endurance. Regular sizes for iron or steel, 8 inches to 14 inches long, measured from center to center of hole. 14 teeth per inch

The GP /888 brand is manufactured to fill the demand for a more moderate priced blade suitable for all-around work. Special improved equipment enables us to make these high grade blades and to

sell them at a very low price. We do not claim that they are the equal of the G brand, but we do guarantee that they are of the very highest grade that can be bought at the price. Regular sizes for iron or steel, 8 inches to 12 inches long. 14 teeth per inch.

The GP/777 brand is especially suitable for electricians and plumbers. Blades will not break even when subjected to severe twists and side strains. They are made from the best hot rolled steel sheets, and have hardened teeth and backs, but soft centers. This gives a quick-cutting serviceable blade that cannot be broken by any ordinary use. Regular sizes for iron or steel, 8 inches to 12 inches long. 14 teeth per inch.

Each of the above brands is also manufactured in 8-inch to 12-inch lengths with 20 teeth per inch for brass or tubing.

We also manufacture blades for extra heavy work and for use in power machines. These blades are of the same quality as our G brand. The materials we use and the care we exercise make possible a standard of excellence known and recognized the world over.

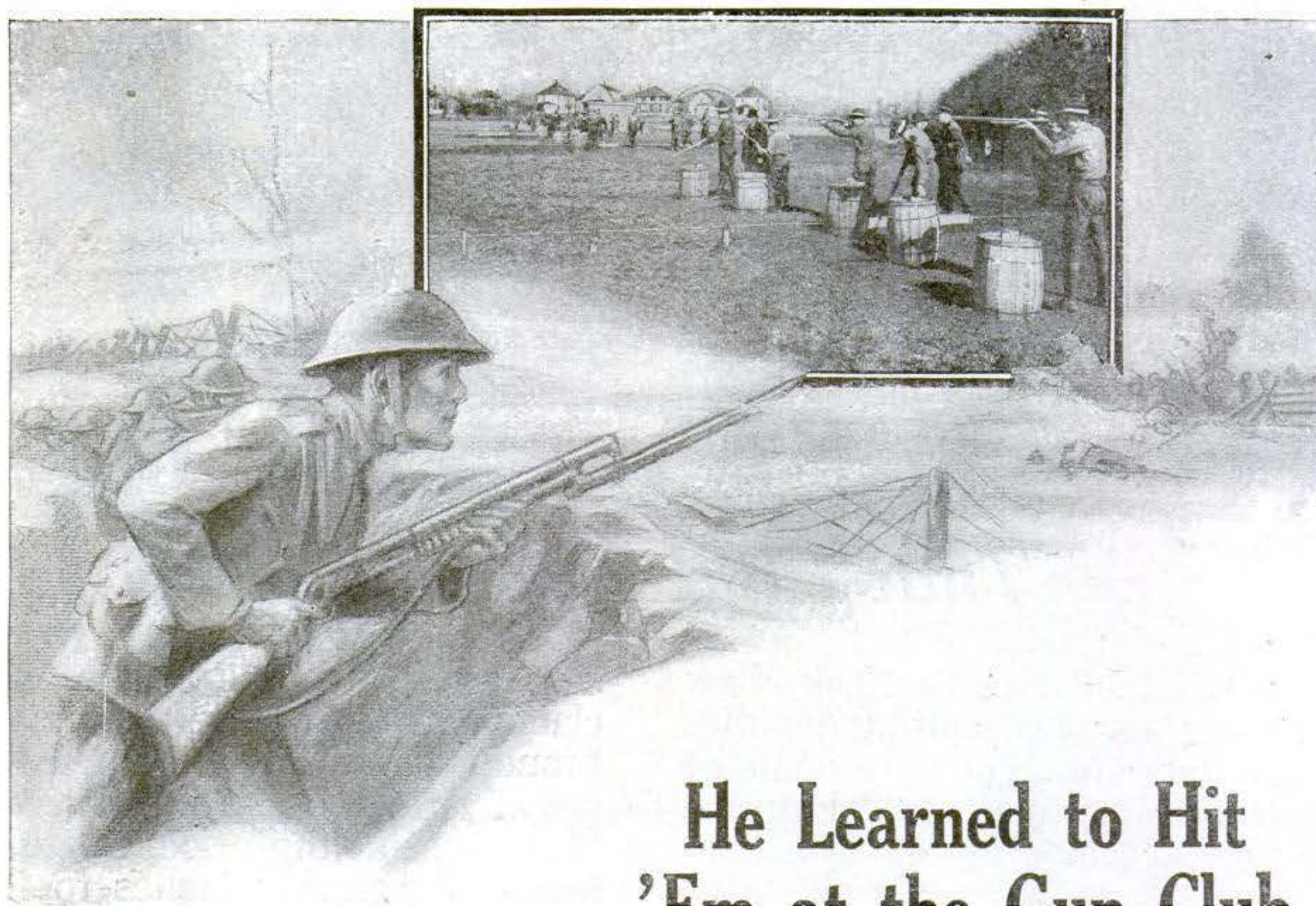
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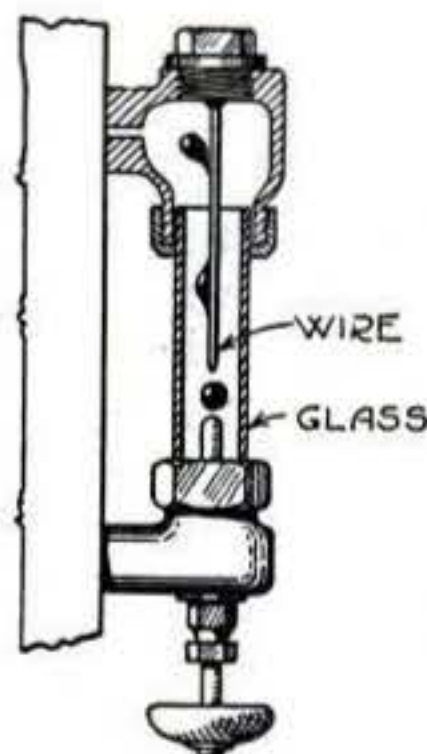
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Visit The Du Pont Products Store
Boardwalk, Atlantic City, N. J.

DU PONT

Assisting the Oil Feed of Small Lubricators

A NUMBER of small lubricators about a plant continually gave some trouble when forced to feed certain kinds of cylinder oil. The oil failed to rise rapidly in the water from the feed nozzle, but would hang over the nozzle, merging into a drop of considerable size. When the drop let go it would rise some distance and be thrown over on the sides of the



Wire in gage to guide oil drops

glass, discoloring it. The drop would then rise very slowly to the reducing or choke opening at the top. It was apparently no fault of the lubricator in construction or application, because oils of a different brand would work very nicely. The oils which gave the trouble, however, were perfect in results as far as lubricating the steam

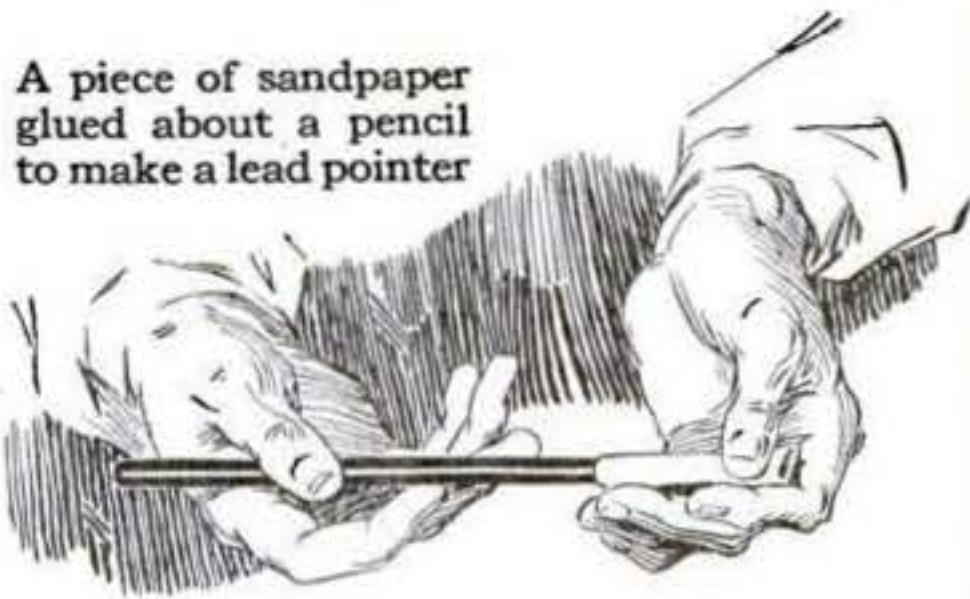
cylinders were concerned. It was up to the power department to use the oil furnished, no matter what minor difficulties were encountered, and this is the same in many other instances.

The illustration shows how a piece of wire about No. 18 gage was soldered to the inside of the bracket cap, and allowed to extend down into the glass to within about $\frac{1}{4}$ or $\frac{3}{16}$ -in. of the tip of the feed nozzle. The oil drops then when free of the oil feed nozzle at once engaged the wire and quickly flowed along it to the top of the glass and through the choke. No further trouble was experienced with the oil or glasses. —F. W. BENTLEY.

Use Sandpaper as a Lead Pointer and Finger Grip

GLUE a strip of sandpaper of the desired degree of grit and about 2 in. long around a pencil with the smooth side out so that it will slide with a snug fit on the wood. To sharpen the point simply slide the paper

A piece of sandpaper glued about a pencil to make a lead pointer



pointer forward a little to cover the lead and twist slightly with the pressure of thumb and forefinger, then slide the pointer back to a working position and the pointing job is over quickly. After a little practice the simple act is accomplished almost unconsciously and without any sensation of interruption, and the pointer is ever at hand. —W. B. SMITH.

"YANKEE" Ratchet

Multiplies Man's Power



These "YANKEE" Ratchet Screw-drivers actually take the place of your muscles and effort in the alternating "grip and let go" action necessary to drive a screw.

You grasp the handle—once. Turn to and fro and the "YANKEE" Ratchet does the rest. It grips on the forward turn and releases on the back turn better than your hand can possibly do it with a common screw-driver.

To draw the screw reverse the Ratchet adjustment with your finger tip. The Ratchet then moves backward, and out comes the screw.

With the "YANKEE" you keep a continuous pressure on the blade in the slot and a steady grasp on the handle. No excuse for "losing the slot."

"YANKEE" Ratchet Screw-drivers give you three adjustments; Right-hand for driving, Left-hand for drawing, or Rigid. All done with your finger tip. Real savers of time and tire. Polished steel blades, nicked bodies, polished hardwood handles.

"YANKEE" Ratchet Screw-drivers

	No. 10	No. 15
2 in. Blade	50c	50c
3 in. "	60c	55c
4 in. "	70c	60c
5 in. "	75c	65c
6 in. "	85c	70c
8 in. "	95c	75c
10 in. "	\$1.10	
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No. 15 has the handy Knurled Washer for starting wobbly screws with thumb and forefinger, while hand steadies the driver. Diameter of blade, $\frac{3}{16}$ inch.

Write for this free "YANKEE" Tool Book of improved screw-driving, wood-boring and metal-drilling and tapping tools.



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"YANKEE" TOOLS

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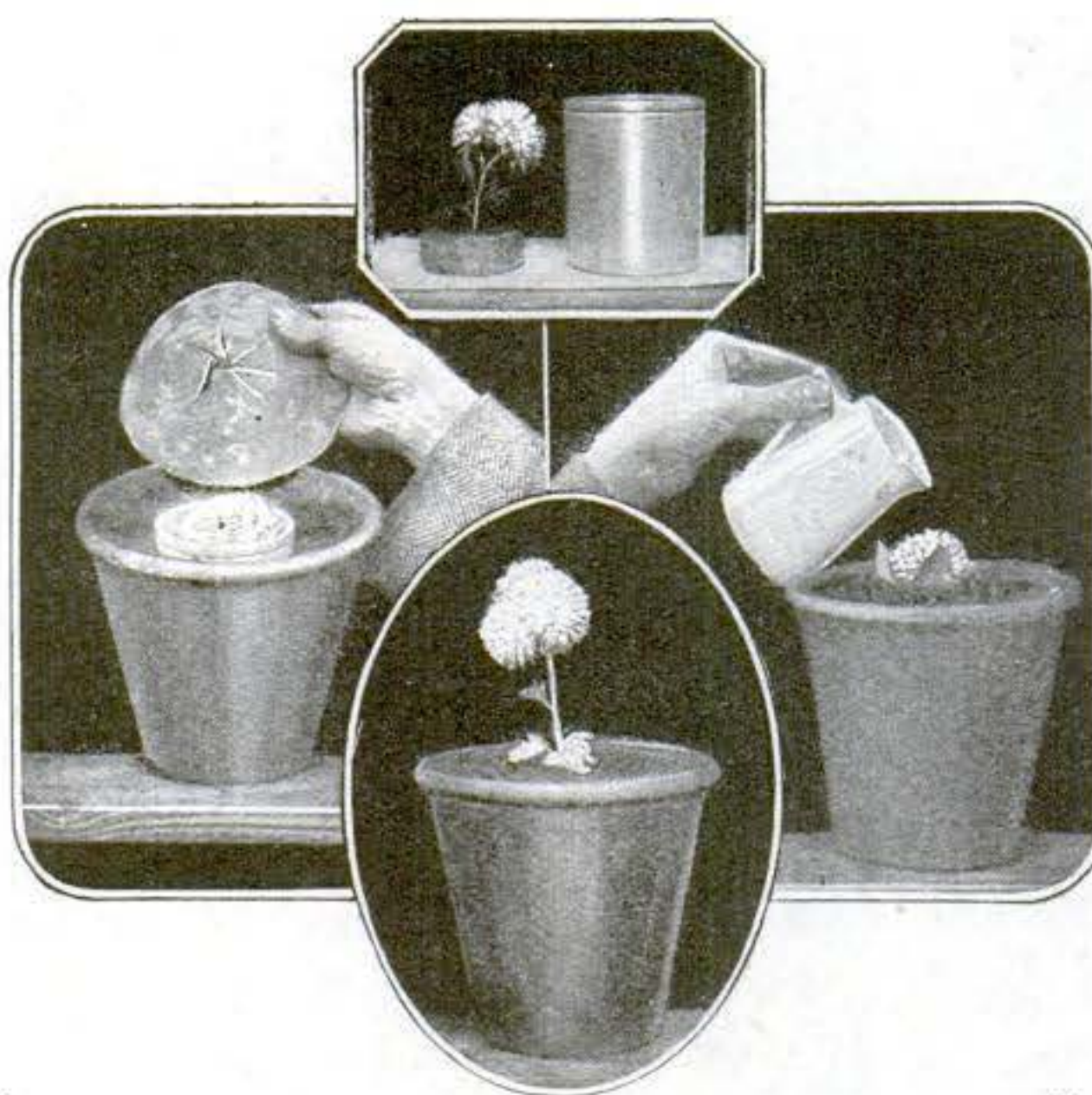
A RATHER puzzling trick, which has often been performed in the Far East, is really very simple if you know how it is done. The whole thing is carried on right out in the open and at no time is there any covering up of the articles used. This is what the observer sees: The conjuror places a pot of soil on the ground. In the center of this he plants a seed. Then he tells his audience that he has invented a magic liquid that will make the seed develop and grow into a flowering plant all in a moment. As soon as the seed is in the soil the demonstrator takes a jug containing, as he says, some of the magic fluid, and pours a quantity on the soil. Almost at once there arises a little plant with leaves and flowers. If those standing around have any doubts as to the reality of the plant he is willing to cut it off at the roots and to hand it to the doubting Thomases for inspection.

The trick is such a neat and effective one that many people may like to know how it is carried out. Glance at the pictures and the idea of the thing will become plain. In the first place the pot has a jar within it. This is placed in the center and soil is pressed all around the sides. Next a thick piece of rounded cork is cut in such a way that it will move freely up and down in the jar. Into the center of this is pushed a sprig of some plant with foliage and flowers. To cover the top of the pot a circular piece of paper is cut. Right in the center the paper is divided into slips very much after the manner of a stage trap-door. The surface of the paper is then gummed over and covered with fine earth which sticks closely.

With these objects at hand the pot may be prepared for the trick. It is understood that the inner jar is in position and that soil has been filled in around the space between it and the pot. Drop the cork with its piece of a plant into the jar. The top of the sprig should be just below the edge of the jar. If it should be too high, a portion of the stem might be broken off, and thus the whole trick would be exposed. Now spread the piece of earthed paper over the top of the jar and the pot. A thin layer of fine soil may also be added to cover everything up. The trick can now be carried forward.

The magic fluid is simply water, although this might be colored to make it appear somewhat more mysterious. A real seed is pressed down into the soil. Then the water is poured somewhere near to the center where you know the paper has been divided. You will, of course, be pouring water

into the jar. As the jar fills, the cork bearing the piece of plant rises upwards. This pushes its way through the paper trap-door, and, in a few moments, a perfect little plant has appeared. The flowers and leaves are



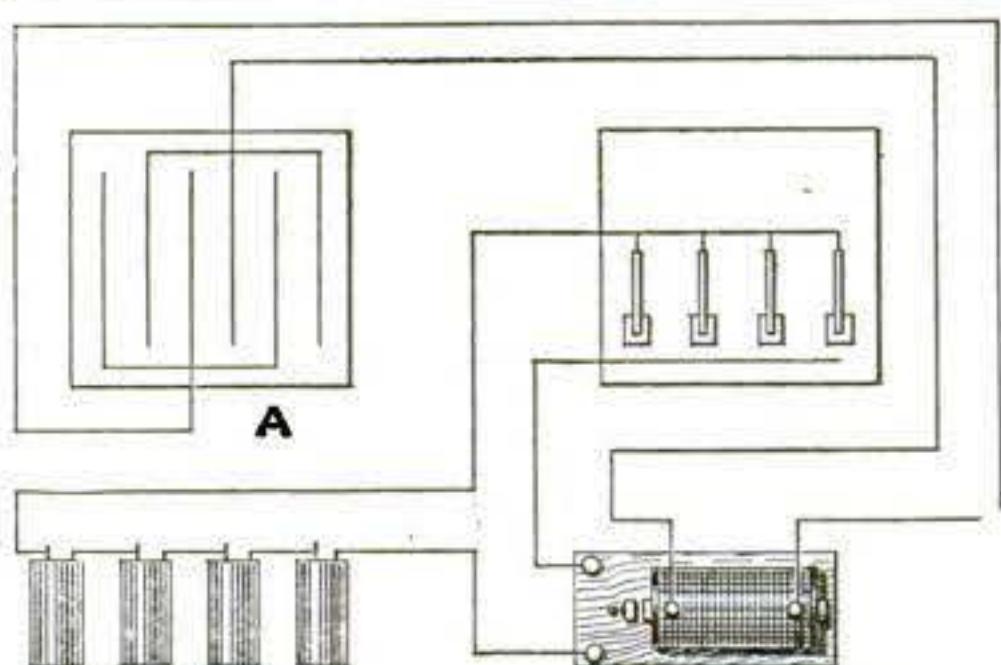
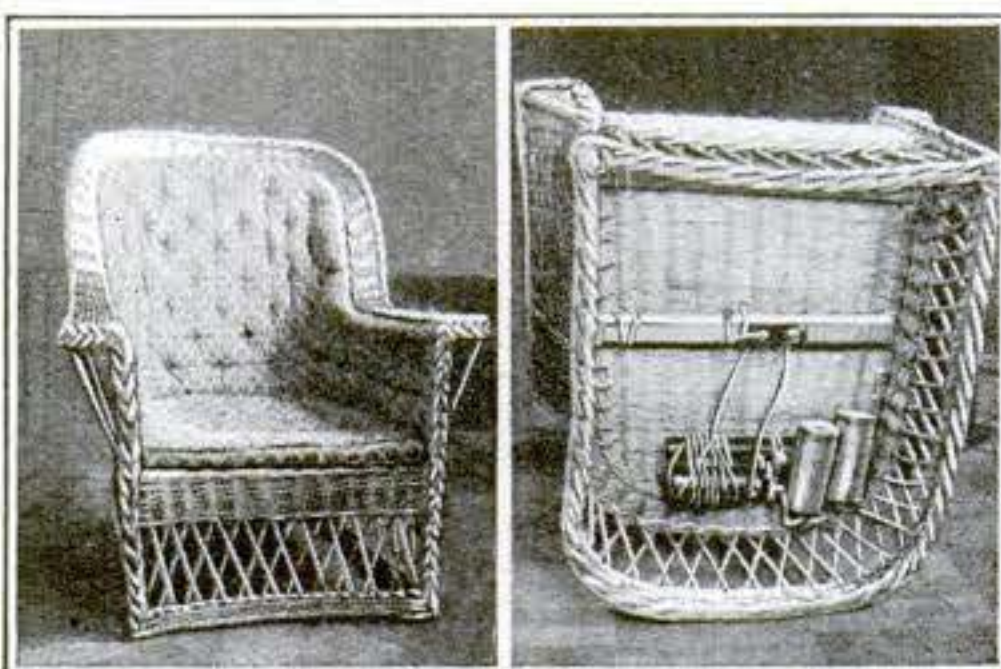
The plant attached to the cork rises as the water is poured into the jar

real and it is easy to satisfy the audience on that point.

This trick is a very striking one and it always impresses people who are not "in the know" seeing that no covering cloths are used at any stage.—S. LEONARD BASTIN.

Electrical Attachments to Make a Surprise Chair

A GREAT deal of amusement may be obtained by means of a little induction coil and a comfortable arm-chair. The spark coil giving a $\frac{1}{4}$ -in. spark (a larger coil, such as a wireless



The innocent-looking chair and the electrical attachments to make you jump

coil, will answer) is fastened under the bottom of the chair and connected through a contact switch with two dry batteries, also fastened under the chair. Six fine, black iron wires are sewed along the seat of the chair, as shown at A in the drawing.

An unsuspecting friend comes in, anticipating a comfortable lounge in the big chair; but he no sooner sits down than buz-z-z-z-z, goes the spark coil, giving the friend the sensation of being pricked by a thousand little needles. It is interesting to study the methods of arising. Some kick their feet out and lift themselves by their arms; others fall forward and a few straighten up; but no matter how they do it, none loses any time in parting with the easy chair.

An interesting variation was effected by replacing the spring connection under the chair seat by a push-button, wired up to an inconspicuous place on the opposite side of the room. Much amusement is obtained by choosing the psychological moment to give the button a push. Some unsuspecting persons may even be given two or three short, quick jogs before discovering the cause of their discomfort.

The contactor can be made from an old clock spring or a piece of spring brass wire tacked onto a thin board as shown. To make contact assurance doubly sure, several such contactors may be connected in multiple under the entire width of the chair seat.

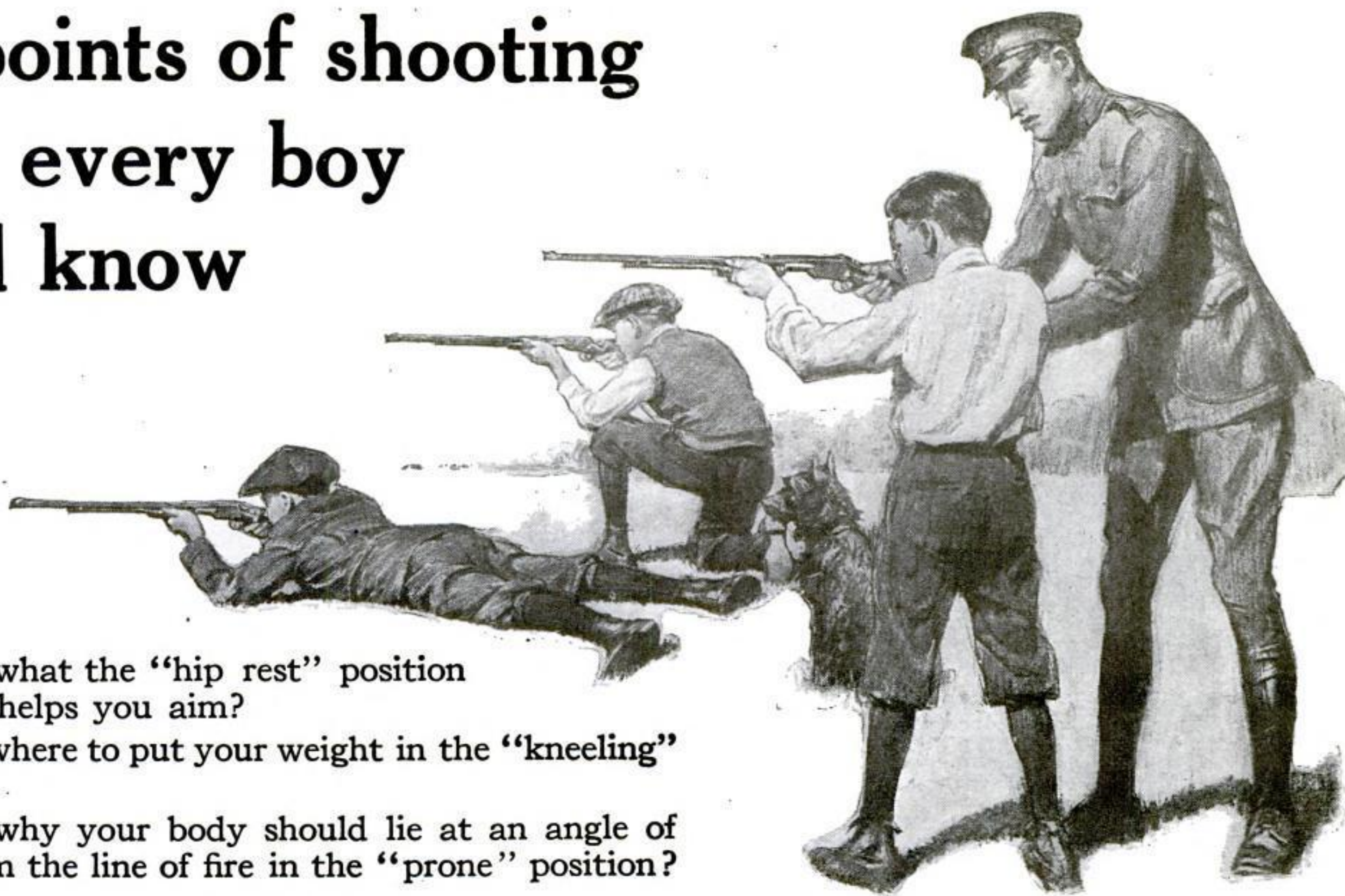
Making Tape from Cotton Cloth for Electrical Work

A CERTAIN Middle Western electrical repair shop, owing to a shipment of cotton tape "being" held up, was confronted with the problem of obtaining an amount of cotton tape of different widths, ranging from one-half inch to two inches, sufficient to keep its maintenance men at work until its order arrived.

After considerable thought, the following was decided upon as a temporary remedy. A bolt of white cotton cloth was purchased in a near-by dry-goods store. The cloth was rolled tightly on a half-inch dowel, and then marked off to the various widths on the outside; a band-saw was used to good advantage, cutting the cotton cloth into tape.

As this tape had no selvedge, something had to be done to prevent it from unraveling. Both edges of each roll of tape were given a heavy coat of shellac, and before it dried the alcohol was burned off. This has a sort of semi-baking effect that tends to strengthen the tape; it also prevents the tape from curling.

Fine points of shooting which every boy should know



Do you know what the "hip rest" position is, and how it helps you aim?

Do you know where to put your weight in the "kneeling" position?

Do you know why your body should lie at an angle of 45 degrees from the line of fire in the "prone" position?

THESE are some of the fine points of rifle shooting that you learn when you join the Winchester Junior Rifle Corps, and compete for the famous Winchester Marksman and Sharpshooter Medals.

Every member of the W. J. R. C. receives at the very start an authoritative rule book on the proper handling of firearms. This book not only gives rules for the safe, intelligent use of a rifle, but goes into the finer details of shooting. It teaches you the approved positions for firing. It shows you how expert Marksmen get best results.

How to become a member

It costs nothing to join the W. J. R. C. Any boy or girl not over 18 years is eligible. There are no military obligations or dues. The W. J. R. C. is purely an honorary organization to encourage marksmanship among the boys and girls of America.

Go to W. J. R. C. Headquarters in your town. Your hardware or sporting goods dealer is probably a representative. Register your name, and receive a free certificate of membership, a membership button, and a rule book.

You then become eligible to compete for the Winchester Marksman and Sharpshooter Medals.

The W. J. R. C. rule book gives full details about the conditions of the contest—how to secure targets, how to make them yourself, how to score, how to get the target certified, and what sort of score entitles you to the medals. All scores must be made with a .22 caliber Winchester, and Winchester ammunition, or they don't count.

Organize a local unit

There are probably a dozen or more of your boy friends who want to learn more about rifle shooting. Why not get together and organize a *local unit of the National Winchester Junior Rifle Corps*?

It makes a lot more fun if all your chums are trying for the Marksman, and Sharpshooter Medals, too. You can start an additional contest to see which one of you qualifies first, which one second and so on—for you all have a chance to win medals. Your unit can also compete with units of other towns.

If neither you nor your chums own a .22 caliber Winchester, you can buy one for a very reasonable sum from your dealer, who has a rifle to suit

every boy's pocketbook. It is really much better for each one to have his own rifle, but to start off with, several of you can chip in and buy a rifle between you.

The right rifle to use

It doesn't make any difference what kind of model you buy, but it must be a .22 caliber Winchester. It doesn't make any difference in your shooting whether you get a low-priced single-shot rifle or a fine *repeater*. The accuracy of a Winchester is in the barrel and the same quality of steel and the same care in boring go into all. No Winchester barrel varies more than one one-thousandth of an inch.

The same care that is taken with Winchester guns is taken with Winchester ammunition. The two are made for each other.

Get started today. Go to the Winchester Junior Rifle Corps Headquarters in your town and register as a member. If you cannot get all the particulars there, write direct to the **Winchester Junior Rifle Corps, National Headquarters, 275 Winchester Ave., New Haven, Conn., U. S. A., Division 862.**



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Four years ago the Belgian Army, war-worn and weak in numbers, confronted the Germans on the Yser. From Liege to the last narrow strip of their country they had resisted the invaders inch by inch, glorious even in retreat.

At the Yser the Belgians performed a signal service to the Allied cause by holding the Germans while the gaps were being closed in the Franco-British lines to the rear.

Four years have passed, and the same nations are still at

death grips along the Western front. America, too, is there, and has this opportunity because the Belgians kept the enemy from crossing the Yser long ago.

The same unfaltering courage, the same inspiration for sacrifice in our army abroad and in our citizens at home will give us victory.

The complete mobilization of the whole people is necessary and the telephone service has an increasingly important part in speeding the national effort.

More than 12,000 members of the Bell System are in military service. Those that remain at home must fill the gaps and do their utmost, with the co-operation of the public, to help win the war.



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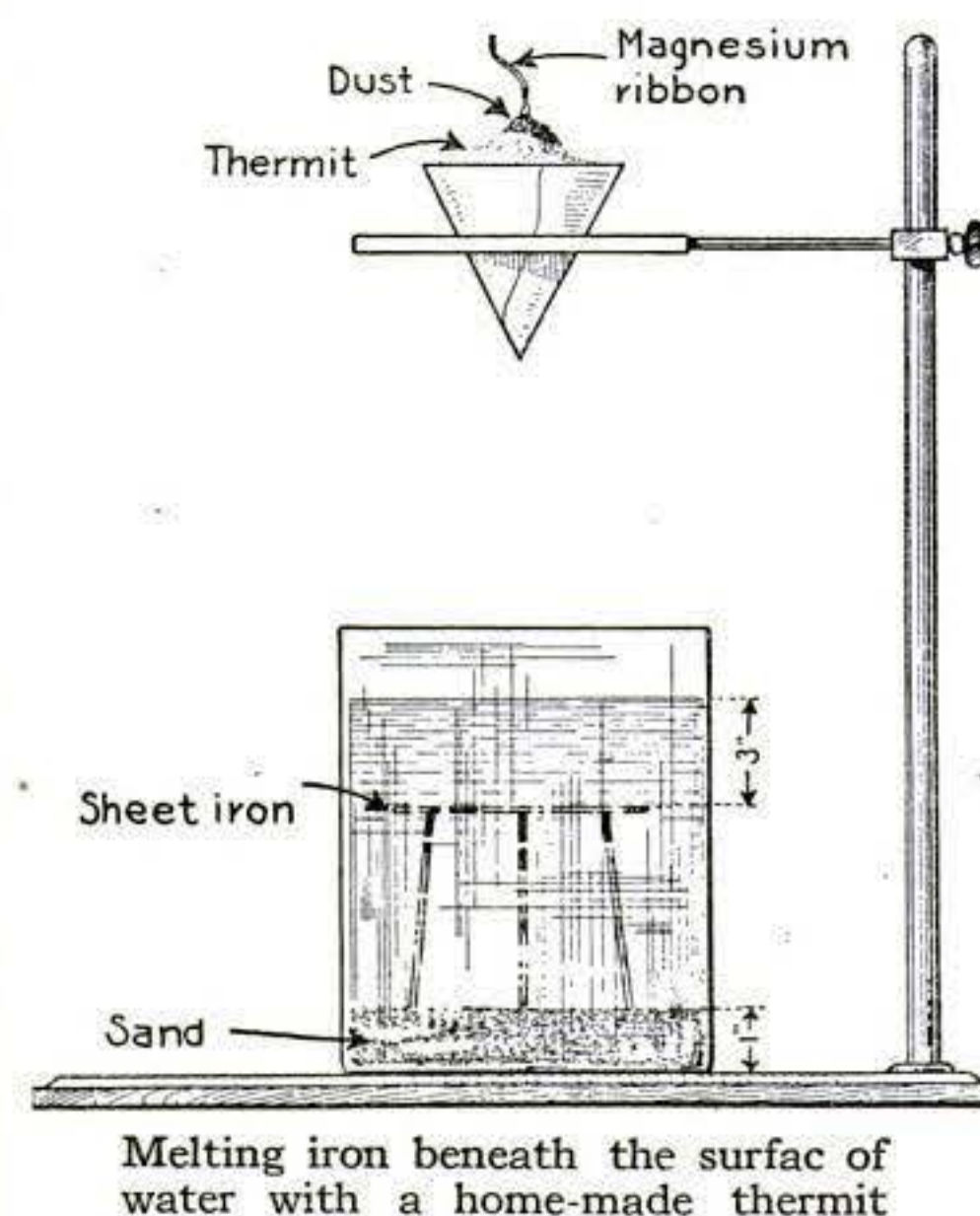
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A Demonstration with a Home-Made Thermit

A VERY striking and spectacular demonstration with a home-made "thermit" can be carried out with the following materials and directions by any boy:

Mix about equal quantities of aluminum dust and red iron oxide—ordinary rouge—on a folded paper and place the mixture over a battery jar of water as shown in the diagram. Prepare the paper by cutting a circular piece about $3\frac{1}{2}$ in. in diameter folding in half and then folding in half again. Then it may be opened up in the form of a hollow cone which will serve as a container for the thermit. At the top of the



conical heap of thermit place a little magnesium dust and thrust into it a $1\frac{1}{2}$ -in. strip of magnesium ribbon. The bottom of the battery jar should contain a 1-in. layer of sand on which to place a tripod or some other support carrying a square of sheet iron. The square of iron may be 3 or 4 in. below the surface of the water. Upon touching a match to the magnesium ribbon the whole mass of thermit will quickly ignite and a stream of white hot molten iron will run into the water and striking the sheet iron melt a hole through it. If the demonstration is made in the evening or in a darkened room a very brilliant effect is produced.

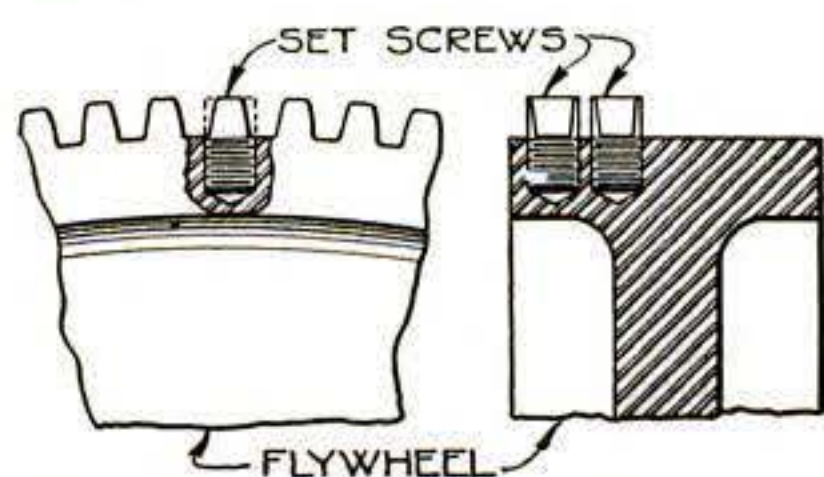
The chemical change consists in the union of the aluminum with the oxygen of the iron oxide, liberating the iron and an immense amount of heat energy.—FLOYD L. DARROW.

New Use for an Old-Fashioned Coffee-Mill

IT is not necessary to throw away that old coffee-mill. Maybe you have one in the attic or among the material cast into the junk pile. Use it to grind those dried pea pods for making soup. The Food Administration now tells us to dry the green pods and grind them into a powder for pea soup. The old coffee-mill is just the thing to do the grinding.—F. H. SIDNEY.

Repairing Broken Teeth on Starting Gear of Automobile

THE fly-wheel gear teeth which are engaged by the pinion on the electric starting motor are sometimes



Set or cap screws used to fill up and form a tooth broken out of a gear

broken off when the engine "kicks." If this happens, one or two teeth on the fly-wheel are broken.

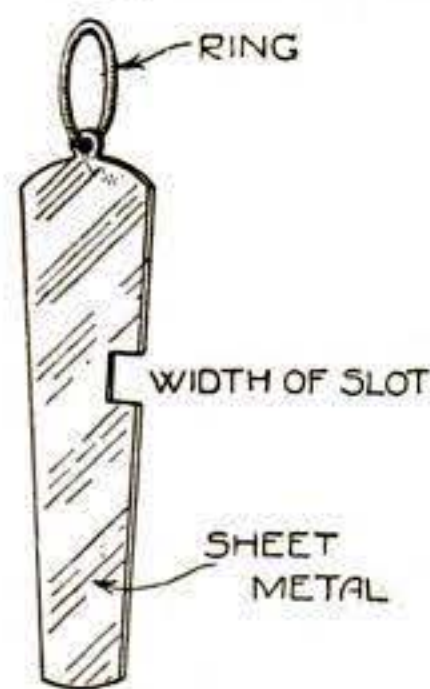
A simple and efficient repair consists in drilling two holes for each tooth, tapping and inserting a set screw in each hole, and filing down the set screws to the shape of the tooth in the gear.—H. C. KIHLSSTROM.

Peach Stones Used for Fuel in a Fruit Country

A cider-mill in a certain fruit-growing country ran short of fuel one season and hit on a novel solution of the problem. From a cannery in the neighborhood the proprietor of the mill obtained peach stones, which made excellent fuel for the cider boiler. The fire from these stones was as hot and steady as a nut coal fire.—F. H. SIDNEY.

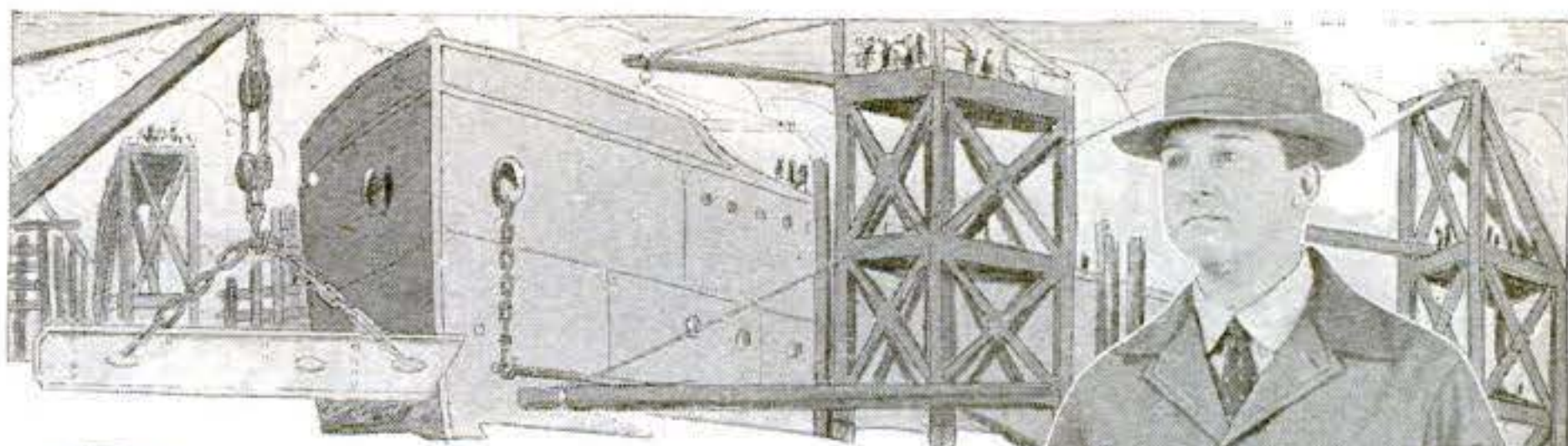
Key Patterns for Marking Size on Work to Cut Keyway

IN a certain shop a great many rod keys of some few sizes were worked up for stock and repairs. As it was quite frequently necessary to consult the prints for dimensions, a pattern



Gage in tag for key size

of sheet metal was made of each different key from the prints, and the class of the engine and the particular brass stamped on it at the top. A slot exactly the width of the finished key was cut in the pattern near the top. The different patterns were then slipped on a ring and hung in the tool room. It was then a very easy matter to chalk or white the blank and scratch the outline of the key for working in the shaper. The ring of templets saved a great deal of necessarily taken in consulting prints, and also time used to lay out by measurement on the blank. The width of the slot and the ring afforded no inconvenience if one did not care to remove any particular templet from the rest of them.—F. W. BENTLEY.



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Coat shown is single breasted. Corduroy faced collar and adjustable corduroy faced cuffs. Entire body and upper half of sleeves lined with Duxbak cloth. Three large outside set-in pockets with flaps, and two large inside patch pockets.

Long trousers reinforced from hip to knee and at seat with Duxbak cloth; cut full and roomy; two side, two hip and two watch pockets with button flaps; belt loops. Trousers can be worn with or without leggings or puttees.

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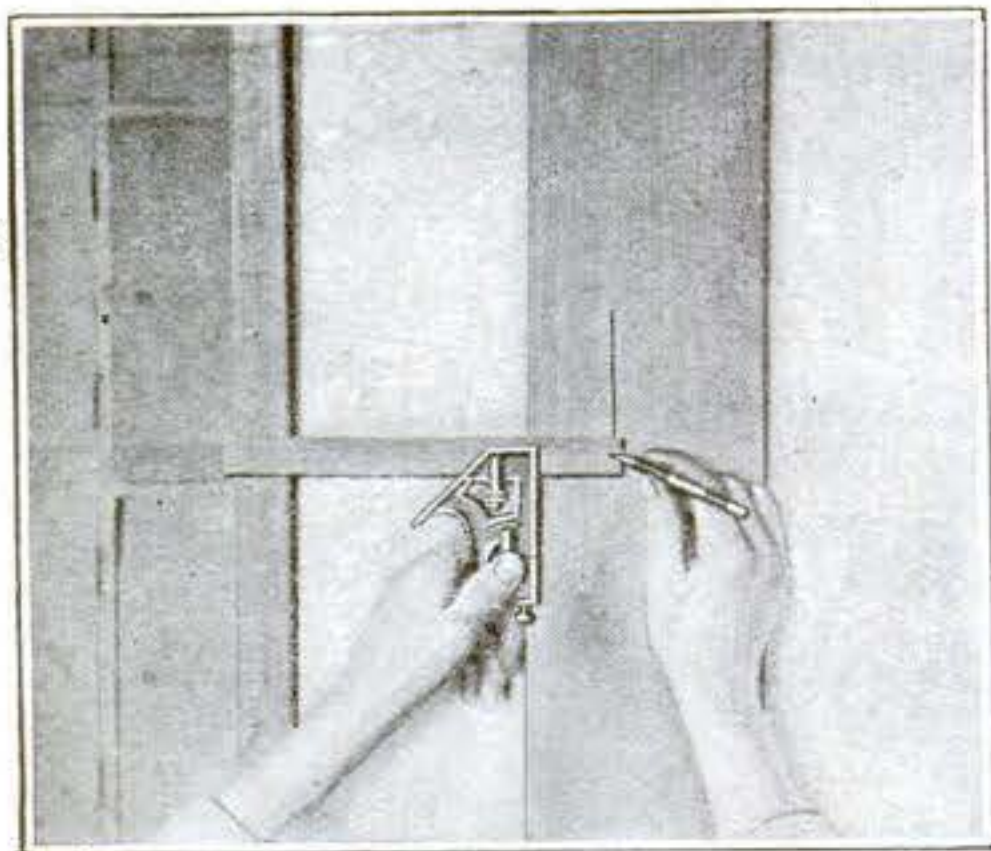
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Hole in End of Square for a Gaging Pencil

A SQUARE with a small hole drilled in the end can be used for a gage, as the pencil point is held in place while the square is drawn along the board.



A hole drilled on a division mark makes a machinist's square a gage

In drilling the hole it is best to center it on a division, like $\frac{1}{4}$ in., $\frac{1}{2}$ in. or 1 in. This makes the measuring easy to figure out on the square when a line is wanted at a certain distance from the edge.—W. E. GAINES.

Camouflage Here Born of a Boy's Reading

AS an example of how odd bits of scientific reading sometimes bear unexpected fruit the following actual experience of one person is of interest. A good many years ago a small boy read a tale of how a company of German troops had marched within forty feet of a small cannon which had been placed amid some brush and had failed to see it because the cannon had been daubed with splotches of paint of various colors.

The small boy grew up, and about eight years ago was a civilian engineer overseeing Government fortification work. It was necessary to paint a small, but important building, which was a part of the coast defenses, because the white concrete was visible from the ocean and could have been seen from enemy ships. Remembering the story of the painted cannon, the engineer asked permission to paint the building according to his own ideas. The concrete was splotched with paints, whose colors as nearly as possible reproduced those of the brush and stones of the surrounding hills. This resulted in a building that could not be distinguished at a comparatively short distance. The odd appearance of the building excited much ridicule; but soon after the engineer was told to

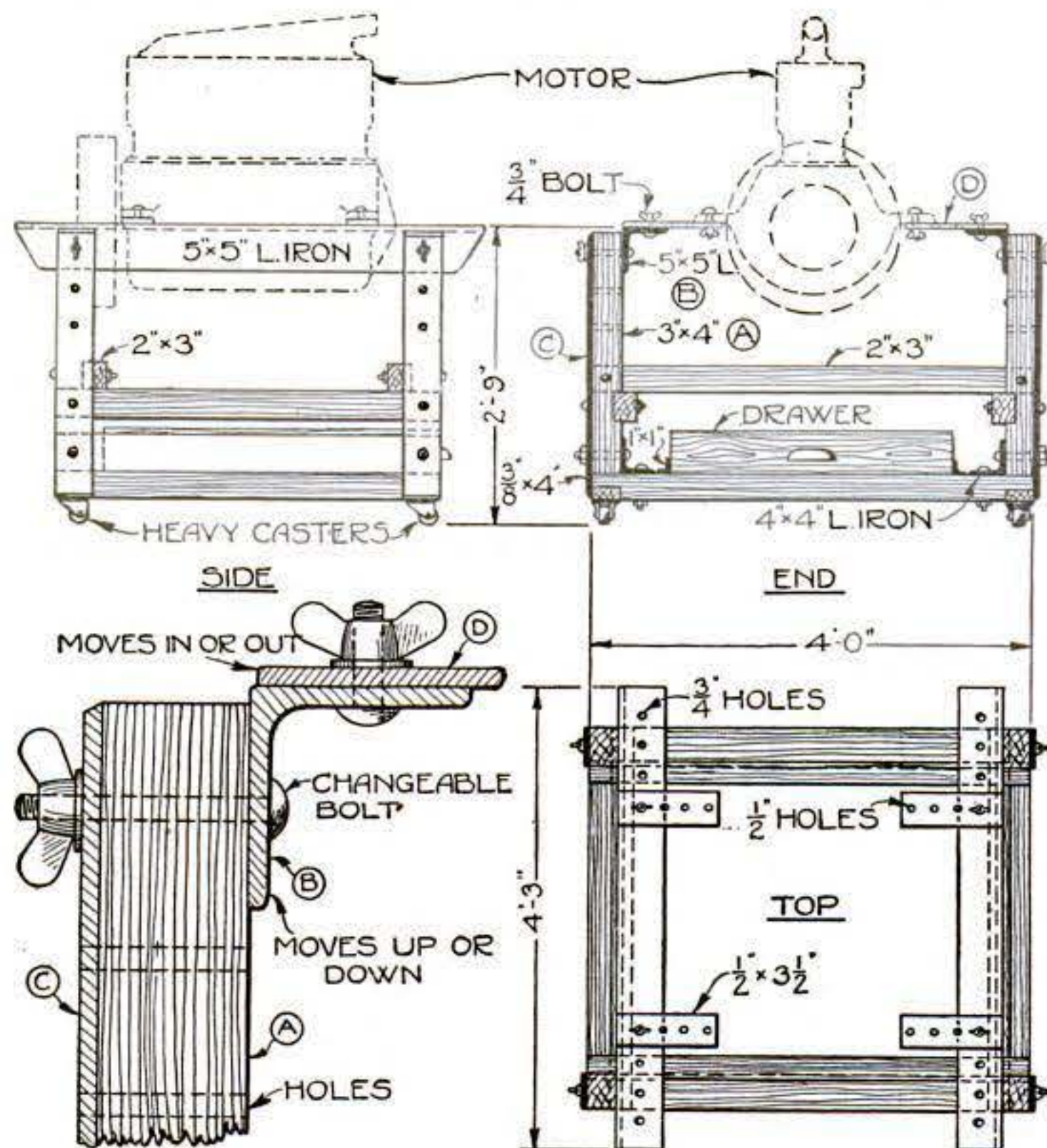
try his painting on other bits of fortification work in concrete. This so successfully accomplished the "hiding" of such buildings that it was presently adopted on coast defenses throughout the United States. This was the first general use of "camouflage" in this country.—M. C. WILKINSON.

A Home-Made Portable Repair Stand for the Shop

IN garages and repair shops this portable rack is a great convenience when overhauling motors, transmissions, rear axles, shafts, gear boxes, pulleys or other pieces of machinery.

Make the frame and cross braces of good, straight-grained spruce, or a similar tough wood. A wood possessing strength of fiber is more essential than one which is hard and brittle. Make the side irons of ordinary band iron of correct height and drill were holes as shown. Use 5 by 5-in. angle irons for the horizontal adjusters and make the supporting plates of the same band iron as that used for the side irons. The holes are drilled as shown. Provide very large casters for each post.

If a series of long machine parts are to be handled, a pair of center posts will be necessary, as the span should not exceed 4 ft. As the irons, with their holes, are easily and quickly shifted from one to another, up or down on the right or left and on top, they make a universal adjustment and

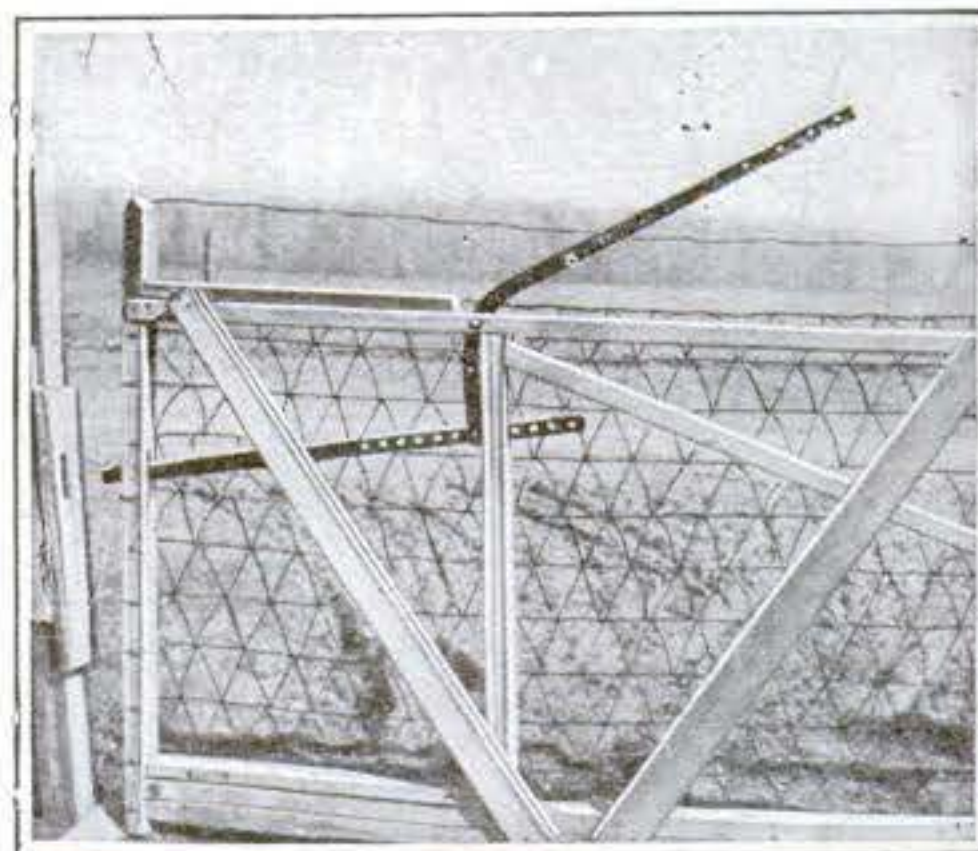


Dimensions for the construction of a portable stand which is adjustable for use in various capacities about a shop and garage

almost any piece of mechanism may be held in a convenient position for work. The entire apparatus can be moved from one place to another in the shop.—P. P. AVERY.

Parts from a Discarded Grain Binder Make Gate Latch

THE parts making up the latch on this gate were obtained from a binder. If these are not obtainable two bars may be forged to take their place.



Pieces of bar iron used on a binder were fabricated to make this handy gate latch

The latch is worked by raising or lowering the top bar. The holes in the lower bar come in handy, as by moving the lever back or forward and setting the bolt in the right hole the distance between the gate and the fence post can be covered.—H. V. STANLEY.

Preparing Silk and Coating It for Photographs

GET some China silk and wash it thoroughly to free it from the dressing. Care should be exercised in washing. The silk is then immersed in the following solution: common salt, 4 parts; arrowroot, 4 parts; acetic acid, 15 parts; distilled water, 100 parts. The arrowroot is dissolved in the water by warming it slightly, and the remaining ingredients added.

A second solution is prepared consisting of 4 parts of tannin in 100 parts of distilled water, and the two solutions are thoroughly mixed.

The silk should be permitted to remain in the mixture for three minutes, after which it should be hung carefully on a cord to dry. A sensitizing mixture consisting of 90 parts of silver nitrate, 1 part of nitric acid, and 750 parts of distilled water is prepared. The silk is floated on the surface of this solution for one minute, hung up until superficially dry, and subsequently pinned out on a flat board until completely dry. These operations must be necessarily carried out in a dark room.

After these preparations the silk is printed, washed, and toned in the usual manner.

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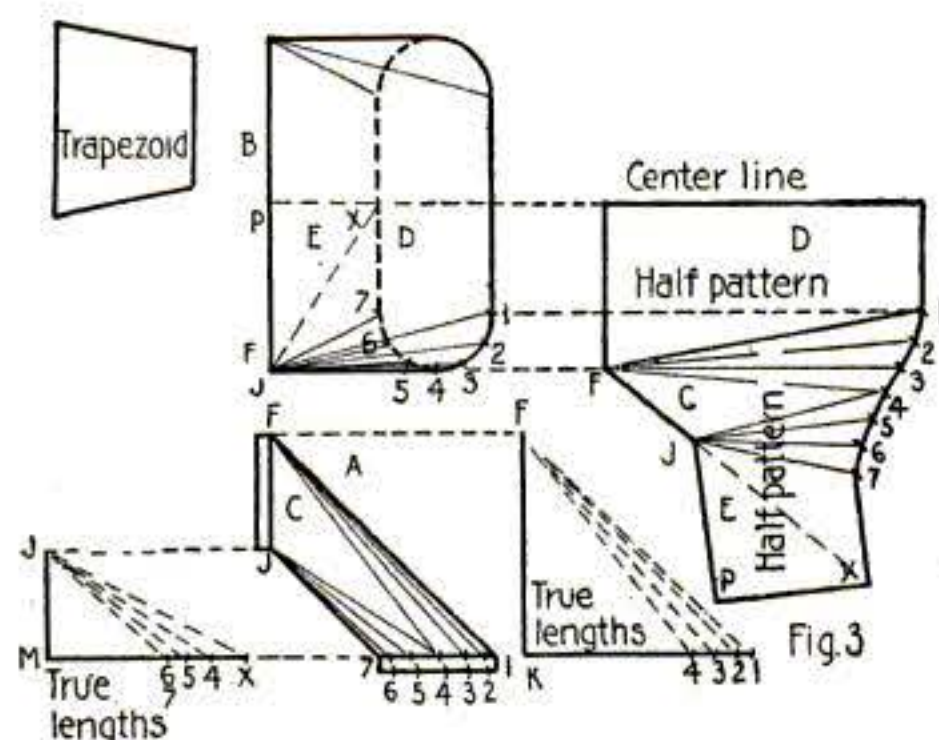
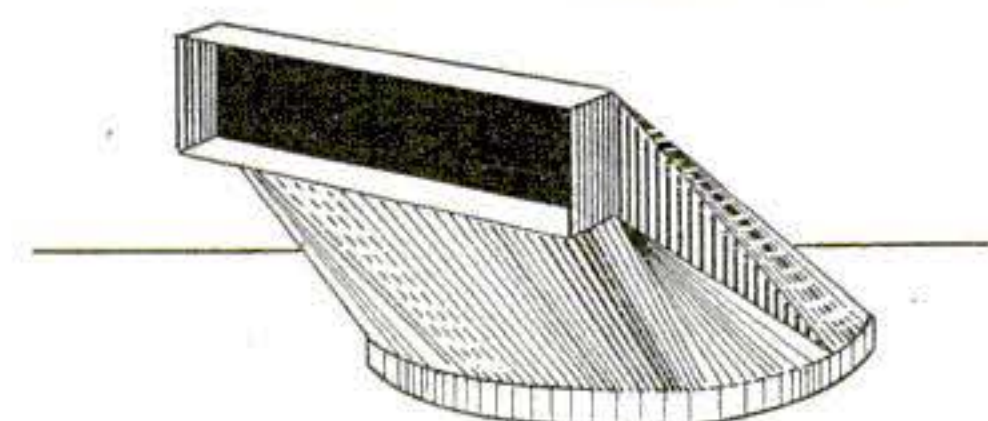
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it exactly in half along the center line of the top, the front view of the cut would look exactly the same as the outline of the front view; this would show that the line *F-1* of the front view is the true length of the center line of the triangle *D*.

Next, we connect the end of the pattern center line and corner *F*. Now we must obtain the true length of line *F-2* and its proper location on the pattern. This can be obtained by the same methods as described in the last two issues. Briefly the method is: Think of the line *F-2* of the top view as the base of a right triangle, and the line *F-2* of the front view as the altitude of that triangle, the third side, or "hypotenuse," is the true length line we want. To draw the true lengths triangle, project the height of the "boot" from the front view over to the left as *F-K*. Take the distance *F-2* of the top view and set it off as



Change boot from oval to rectangular form, using same methods to make pattern

K-2 of the true lengths, the dotted "hypotenuse" line *F-2* of the true lengths is the true length of the line *F-2*. Now to locate it on the pattern, take the distance 1-2 of the top view circle, and set it off as 1-2 of the pattern by drawing a short arc, take the true length line *F-2* and draw another arc from *F* so that it crosses the short arc. Where the two arcs cross is point 2 of the pattern. Do exactly the same with lines *F-3*, *F-4*, *F-5*.

To lay out the pattern triangle *C*, take the distance *F-J* of the front view which is the true length of that line, and from *F* of the pattern strike an arc. Now get the true length of the line *J-5* by projecting the height from the front view to the left as line *J-M*, then set off top view distance *J-5* as *M-5* and *J-5* will be the true length of *J-5*. With this distance strike an arc from 5 of the pattern so that it crosses the arc from *F*, then connect *J* and 5 of the pattern and side triangle *C* is complete on the pattern.

Repeat the process for the lines *J-5*, *J-6*, *J-7*, *J-8*, *J-9*, and for the half side *E*, and the half pattern will be complete. To get the full pattern,

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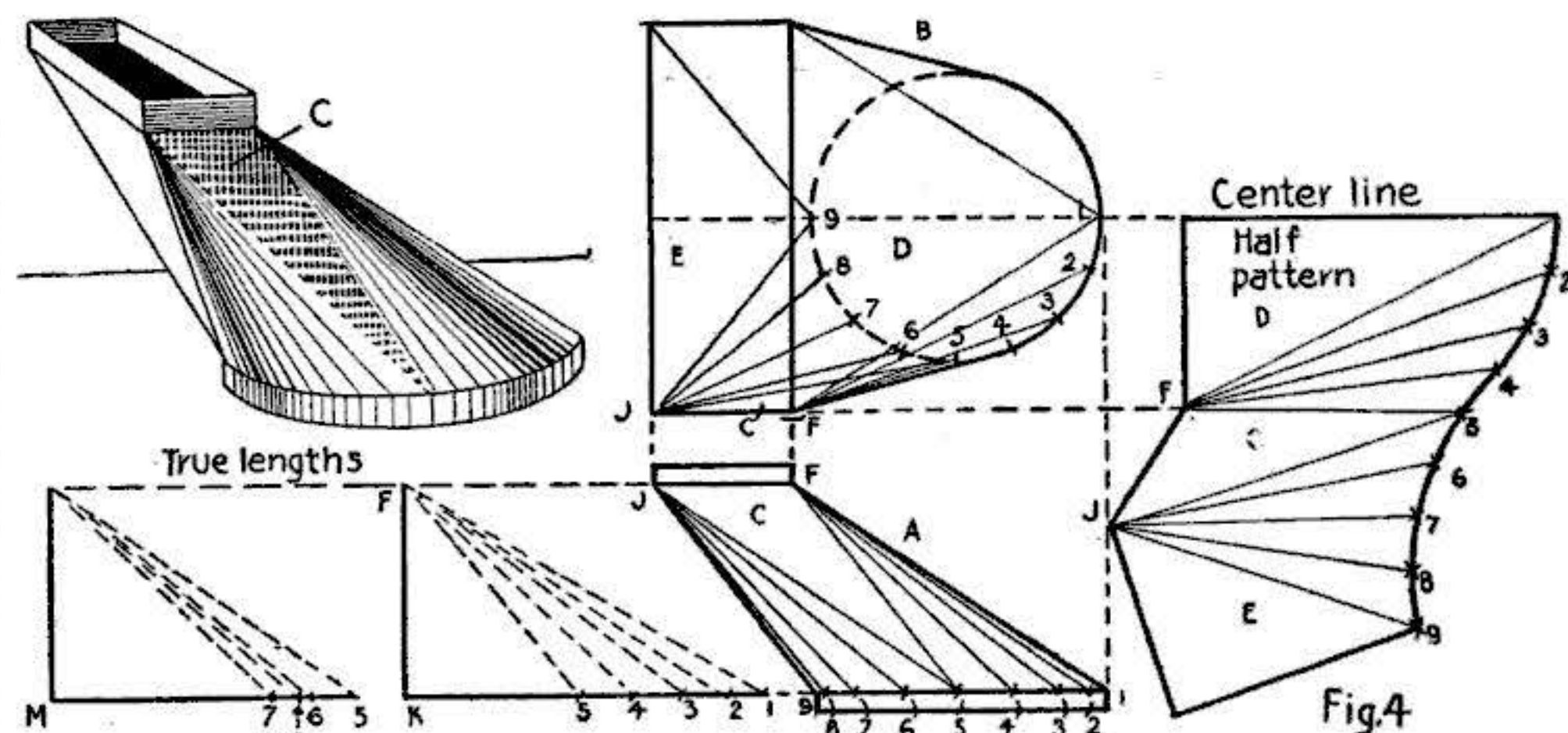
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6B	Varying degrees of	H	Hard.
5B	extra softness—6B	2H	Harder.
4B	softest.	3H	Very hard.
3B	Extra soft and black.	4H	Extra hard.
2B	Very soft and black.	5H	Varying degrees of extra hardness.
B	Soft and black.	6H	
HB	Medium soft.	7H	
F	Firm.	8H	
		9H	

the half pattern must be folded over on either one of the center lines.

The "Ninety Degree Single Boot" shown in the illustration (Fig. 2) is another transitional piece, the development of which has puzzled many an earnest trade worker.

The steps and method for this problem are exactly the same as for the preceding problem. First, draw front view A and top view B. Second, lay out on the front and top views the large triangles C, D, E. Third, lay out the small triangles by dividing the top circle and drawing lines from the circle points to the corners F and J. Right here we find a rather puzzling



An offset single boot appears to be a very difficult pattern to develop; but it is no more trouble than the other problems, since it is done in the same way

point. The points F and J are easily found on the front view, but on the top view we find what is apparently one point lettered F and J, but there really are two points there, one directly under the other, point F on top and J underneath. This will be understood, if we consider that if we were looking down line F-J of the front view from the top, all we would see is a dot. Fourth, lay off the true length triangle as described before and then start on the pattern using exactly the same methods as described for the problem illustrated by Fig. 7.

In problem Fig. 3 we again use the same steps and methods, the only differences being that this boot changes from oval to rectangular where the others have been from round to rectangular. We also find that it is better to lay out this boot into two large trapezoids, and two large triangles instead of four large triangles and several small ones as in the preceding problems. The geometrical definition of a trapezoid is a "quadrilateral which has only two sides parallel." A trapezoid is shown in the drawing. We also make use of an auxiliary line J-X. We have used these auxiliary lines several times earlier in the series.

To avoid confusion, the steps will be given very briefly. Draw front view A and top view B. Lay out the triangle C and the trapezoids D and E. Lay out the small triangles. Get the true lengths and lay out the pattern as described before. When you come to the J-7 of the pattern, you will have difficulty in laying out the half

trapezoid E. The easiest way is: Take distance 7-X of the top view and strike an arc from 7 of the pattern. Take the distance J-P of the top view and strike an arc from J on the pattern. Now draw the auxiliary line J-X on the top view, get its true length on the true length triangle, then take the true length and from J on the pattern strike an arc intersecting the arc from 7. Now take the distance J-7 of the front view, which is the true length of P-X of the top view, and set off as P-X of the pattern by striking an arc from X intersecting the arc from J. This will complete the half pattern.

An "Offset Single Boot" is shown in Fig. 4 and it looks like a very difficult pattern to develop, but it is no more difficult than the preceding problems, and is developed in exactly the same way.

If any of the readers have any difficulty with these problems, it is earnestly advised that they read over again the explanation of the fundamentals of triangulation in the August issue.

It is the intention of the author and publishers to supplement this series with other material when the series is completed, and to publish all the articles in book form. In case our readers desire more light on any particular problem or explanation, it will be a favor to the author if they will communicate with him, as it is his purpose to make this series as clear, concise, and logical as possible.

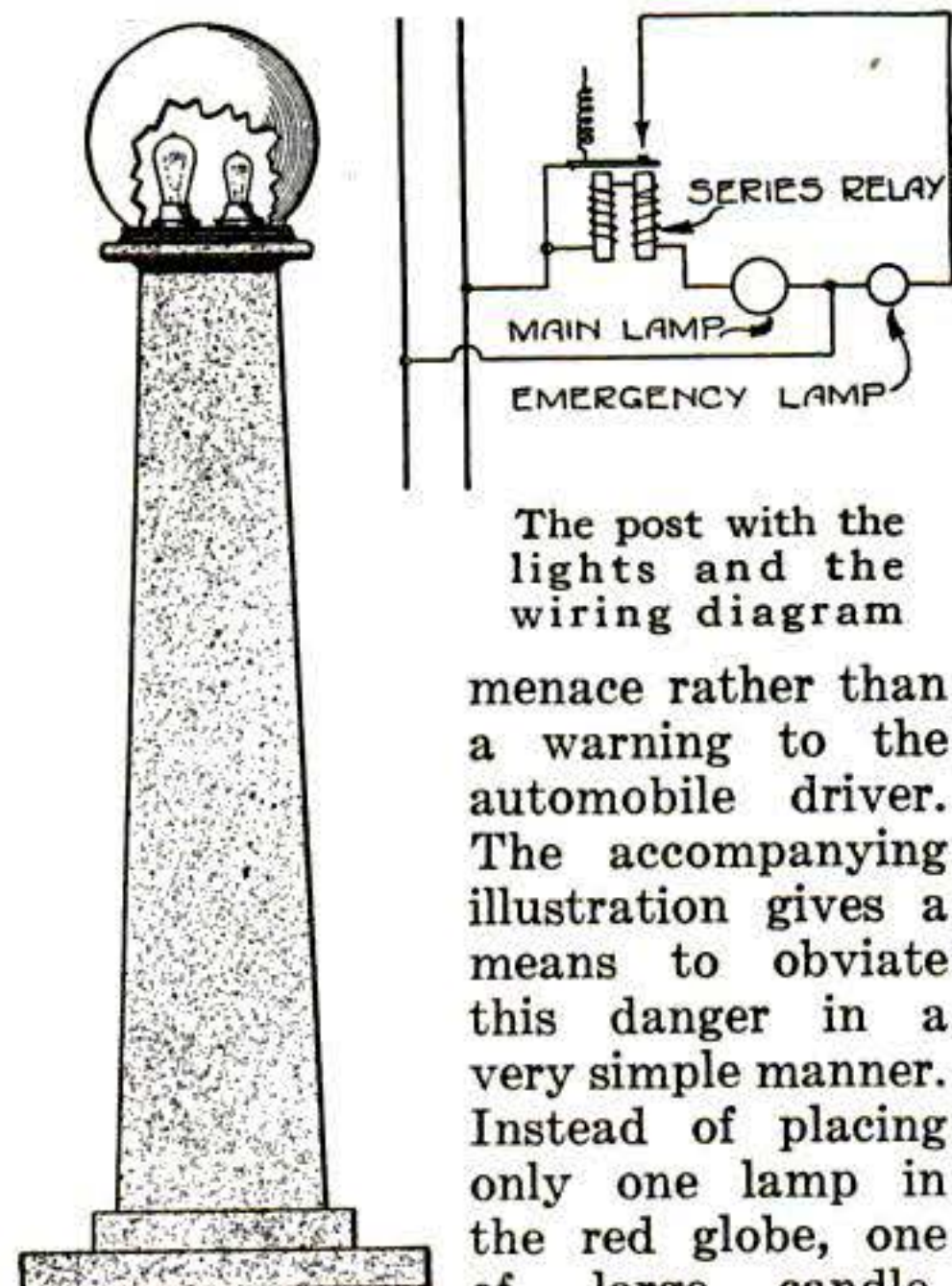
(To be continued)

Making Mechanical Drawings on Glass Lantern Slides

THE magic lantern is generally used now only at technical lectures, explaining, by means of glass slides, details of mechanism, piping, mathematical problems, and the many things that the lecturer alone has use for, and that perhaps for one occasion only. Some squares of ground glass should be procured (ground on one side only) and the drawings made upon the ground surface with a hard lead pencil. When the work is finished, a coat of varnish is spread over, converting the ground glass into a transparent glass with a fixed drawing upon it.

An Emergency Lamp for Traffic Regulating Post

USUALLY only one lamp of large candle-power is placed in the traffic pedestals used as danger signals at street intersections, and should this lamp burn out, as frequently happens, the post at once becomes a



The post with the lights and the wiring diagram

menace rather than a warning to the automobile driver. The accompanying illustration gives a means to obviate this danger in a very simple manner. Instead of placing only one lamp in the red globe, one of large candle-power could be used as the main lamp and a relay inserted in its circuit. A lamp of smaller candle-power would be connected to one side of the line and to the contact point of the relay, while the armature of the relay would be fastened to the other side of the line.

When the main switch is thrown in, the current flowing through the large lamp will cause the armature of the relay to be drawn over, leaving the emergency lamp circuit open. In case the main lamp burns out, however, the armature, actuated by a spring, will throw the emergency lamp in circuit. In this manner the pedestal will be illuminated at all times, and, because of the fact that two sizes of lamps are used, a patrolman or light inspector can tell at a glance that a new main lamp is needed, in case it should burn out.—C. BACH, JR.

The Use of Aluminum as a Hone for Steel Tools

ALUMINUM will put a fine edge on cutting instruments, such as surgical knives, razors, and similar articles. Its action is analogous to that of a razor hone of the best quality. When steel is rubbed on the aluminum, as, for example, a knife-blade, the latter metal disintegrates, forming a very fine powder of a greasy quality that clings to the steel with great tenacity, thereby assisting in cutting away the surface of the harder metal. So fine is the edge produced that it cannot be made any finer by the use of a strop, which used in the ordinary way will tend merely to round the edge.

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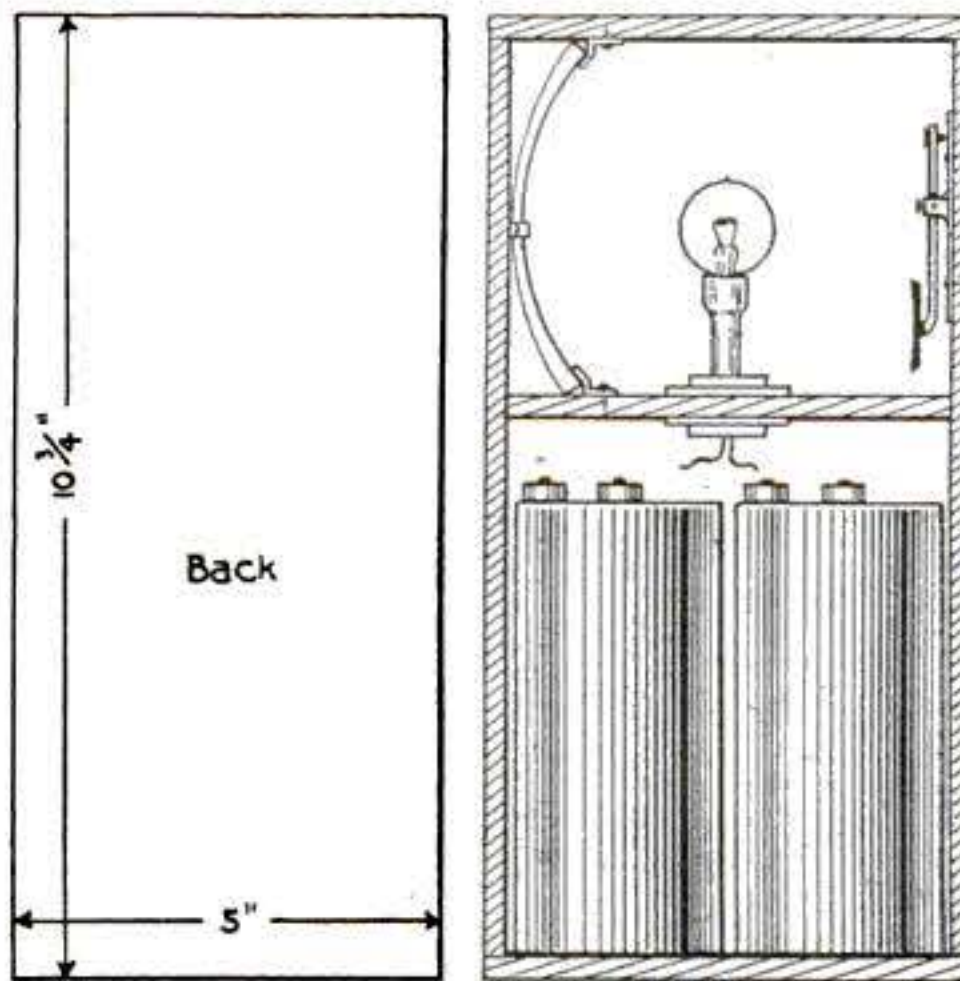
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A Twenty-Five-Mile Electric Signal Projector

COMMUNICATION is one of the most important functions of that branch of our army known as the Signal Corps. Thousands of boys are anxious to train themselves in this



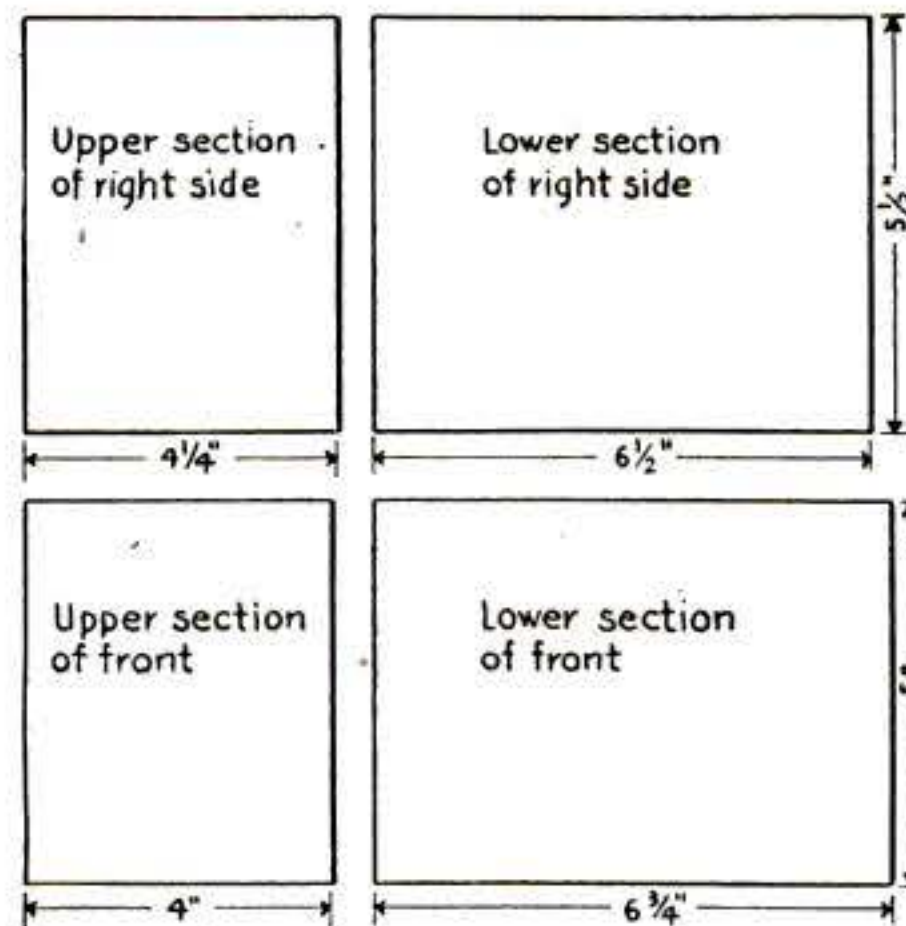
Box containing the batteries, lamp, reflector, and the key to break the circuit

highly specialized field, but have difficulty in obtaining the necessary equipment, particularly now that wireless is forbidden to amateurs.

Any clever boy may, however, with a saw, a hammer, and some inexpensive materials, construct a signal outfit with which it is possible to send messages a distance of 25 miles on a clear night and about 3 miles during the day.

The projector consists of a Mangin mirror, four inches in diameter, an automobile headlight mazda lamp, four dry batteries, and a telegraph key. Mangin mirrors may be obtained at many dealers in automobile supplies, or, perchance, an old acetylene-gas headlight may be robbed of its mirror.

Four standard No. 6 dry batteries, as ordinarily used for door bells, a telegraph key, a mazda automobile headlight lamp (1½ amperes 6 volt G-12 bulb), a socket for the lamp, and a little



Dimensions of the sides and front of the box for the light and batteries

flexible wire can be obtained at almost any electrical supply store.

The function of the Mangin mirror is that it will project a narrow beam, all light originating at its focal point, *i. e.*,

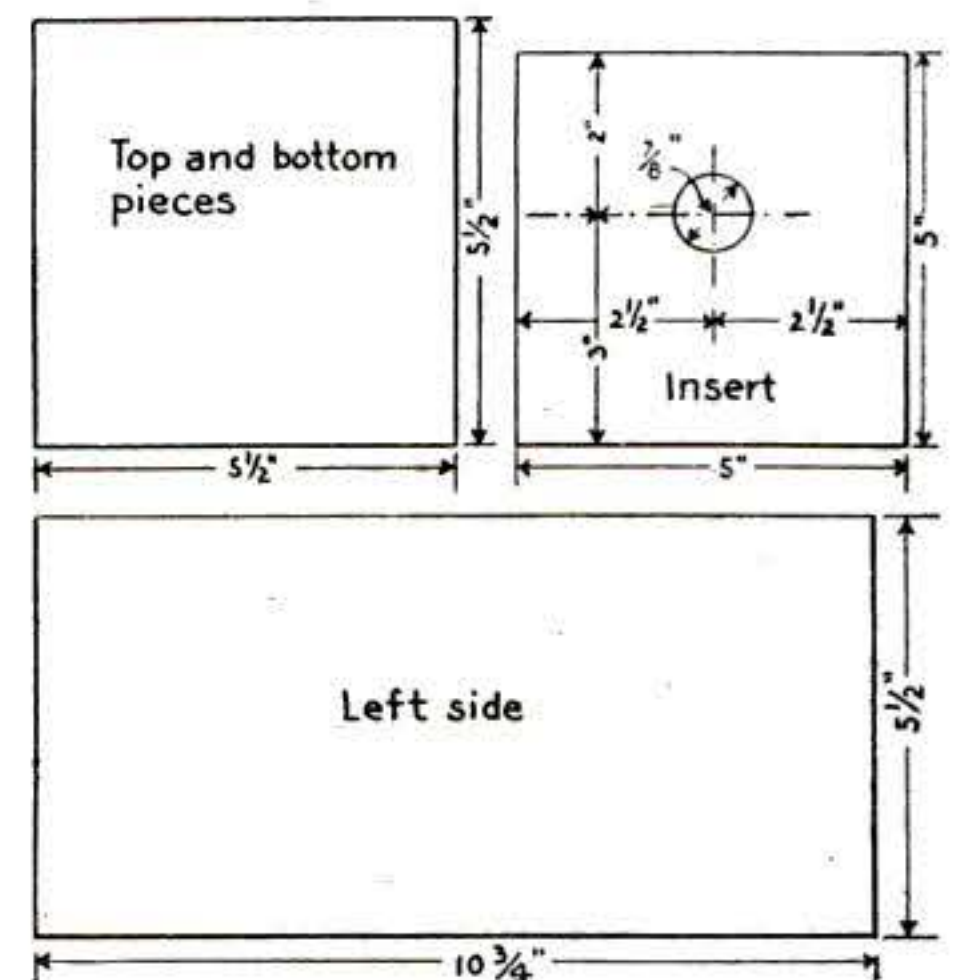
a point opposite the center of the mirror and in the 4 in. size about 2 in. in front of it. This point may easily be determined by moving the lighted lamp around until the mirror projects the smallest spot of light onto a wall a few feet away.

When the narrow shaft of light thus emitted is trained directly at an observer many miles away, the brilliant mirror becomes clearly visible, though no measurable amount of light is delivered on the observer. Then by causing the lamp to light for long or short periods by use of the telegraph key, signals may be sent in the regular Morse or continental code. By closing the switch on the key, the projector may be used as a land lantern.

The equipment may be conveniently mounted in a simple wooden box, as shown in Fig. 1. The lumber necessary to construct this box consists of the following, preferably of oak:

2 pieces....	5½ by	5½ by	¼ in.
1 piece....	5½ by	4¼ by	¼ in.
1 piece....	5½ by	6½ by	¼ in.
1 piece....	5½ by	10¾ by	¼ in.
1 piece....	5 by	5 by	¼ in.
1 piece....	5 by	4 by	¼ in.
1 piece....	5 by	6¾ by	¼ in.
1 piece....	5 by	10¾ by	¼ in.

Four small hinges are required, though pieces of leather or canvas may



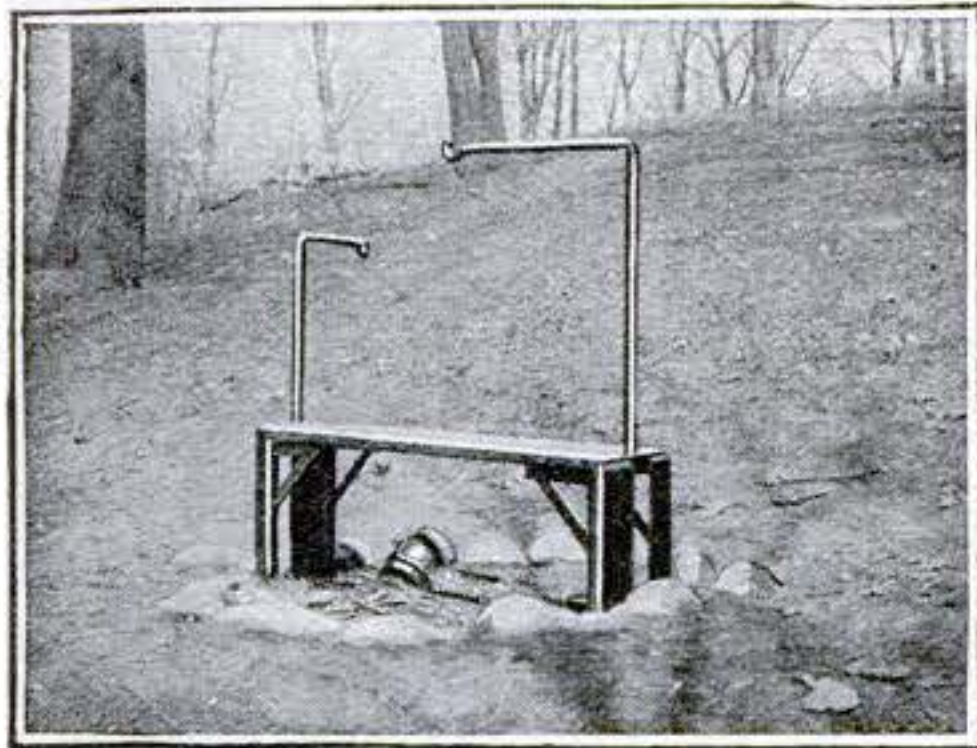
Top, insert, and left side dimensions for the box with location of light hole

be used for this purpose, if desired. A pair of hooks and eyes are handy to keep the doors closed. The mirror is held in place by four small strips of brass bent into the form of clips and screwed to the back of the box.

It is advisable to so support the lamp that it may be moved up and down, forward and back, or crosswise about a ¼ in. This is to allow for focusing. It may be accomplished by putting the socket on a piece of ⅜-in. threaded pipe through which the wires pass down to the telegraph key and batteries. This pipe is held in the insert piece by means of two 1½-in. washers and a couple of lock nuts. The pipe passes through a ⅛-in. hole in the board, thus allowing ¼-in. adjustment each way. The batteries are all connected in series through the telegraph key to the lamp.—L. C. PORTER.

An Outdoor Metal Fireplace with Swinging Cranes

THE illustration shows an outdoor fireplace that has a feature calculated to commend itself to the average picnic party. When the coffee is made, and more or less in the way of the frying-pan or kettle that needs a place



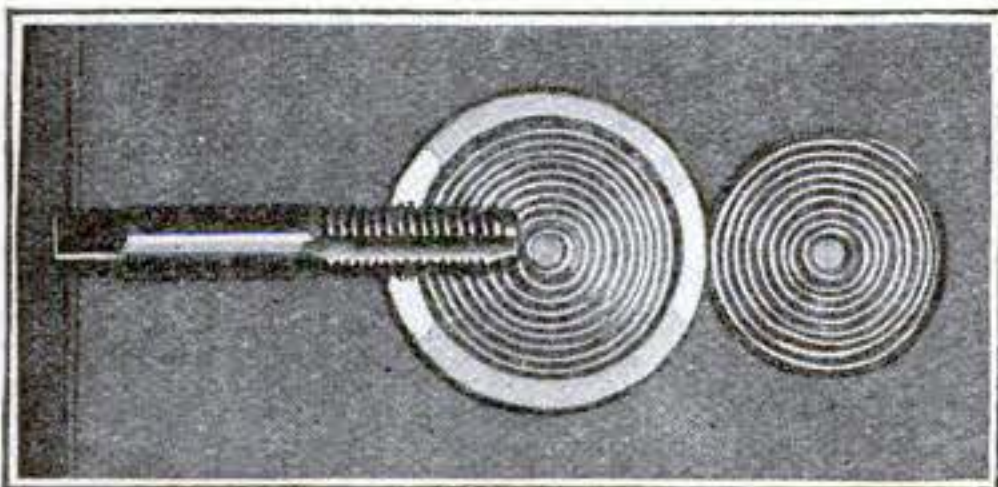
A permanent fireplace, provided with cranes for coffee-pot and kettle over the fire, one simply hangs the coffee-pot on the swinging arm and so gets it out of the way. A kettle can be taken care of in the same manner. The heat of the fire will keep the contents of pot or kettle warm for quite a long time. These arms are so arranged that they can be swung entirely out of the way.—C. L. MELLER.

A Simple Die for Forming Corrugated Diaphragms

CORRUGATED diaphragms, contrary to general opinion, are very simple things to make, even in the ordinary amateur shop where dies and presses are an unknown quantity. This applies of course to work of a fairly light nature only, such as is required to make parts up to, say, 3 in. in diameter.

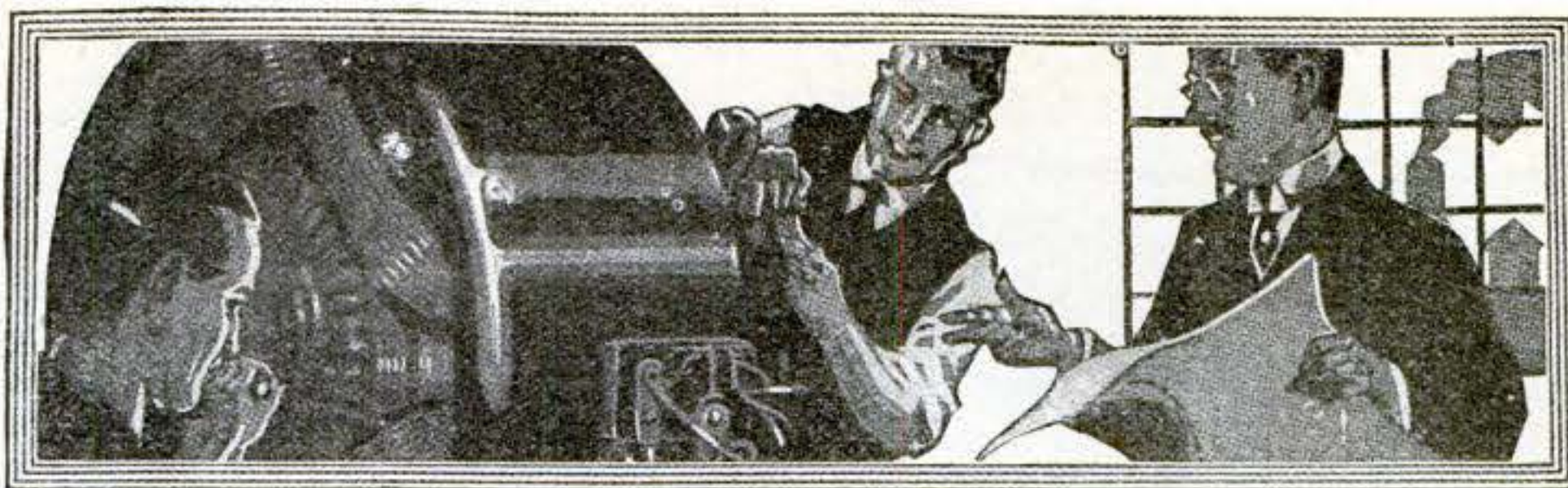
A simple annular ribbed die can be quickly turned out on a small lathe or motor by holding a tap against the face of a brass disk somewhat after the manner shown in the photograph. The number and size of the ribs on the die will vary according to the threading or pitch of the tap used. The die should be at least 3/16 in. thick.

Excellent diaphragms can be struck out by hand, using a heavy hammer or axe and a block of medium soft wood as compression agents. The metal



A way to use a tap to form a die for making corrugated diaphragms

used for the blanks to be stamped should not be much over two thousandths of an inch thick, except where softer stock than spring brass is being used. Brass, copper, and aluminum in thin sheets are the best materials for making diaphragms. A sample of the work done is shown at the right of the picture.—R. U. CLARK, 3RD.

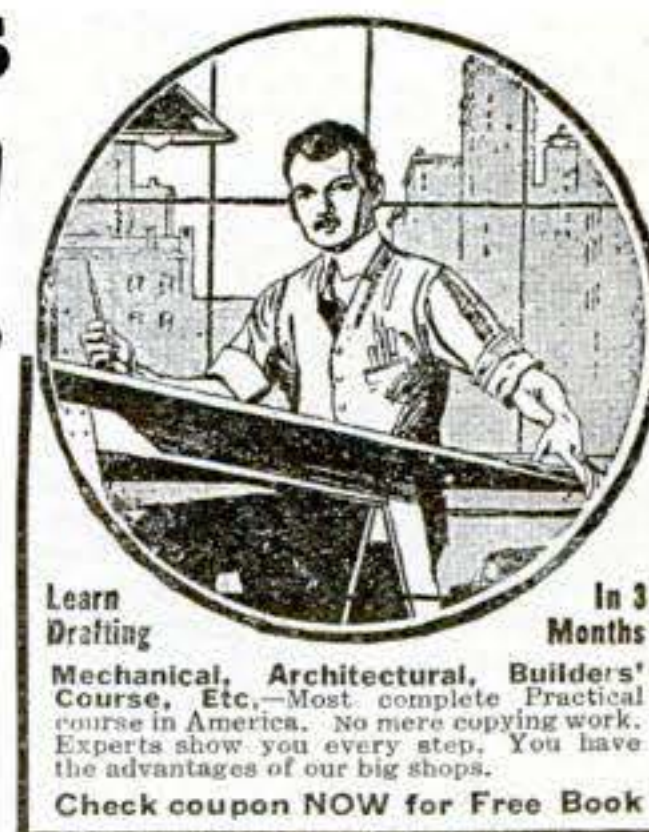


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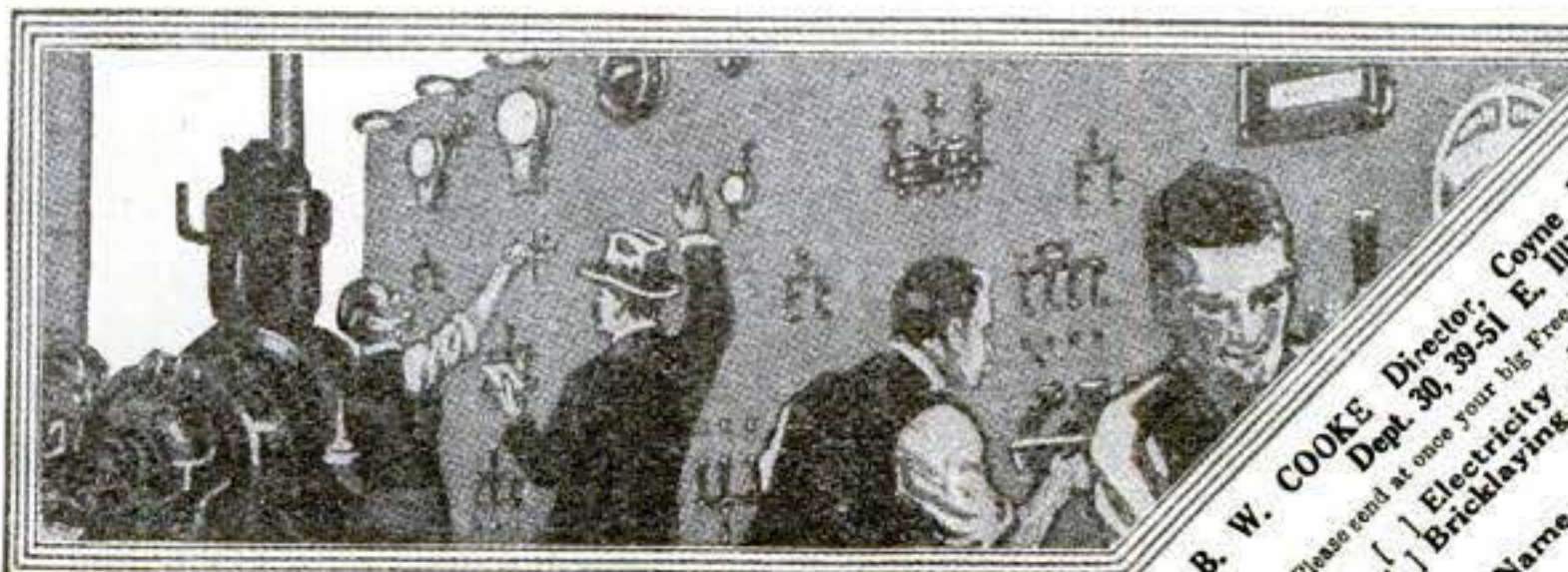
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Electric Lights on a Suit-Case to Light the Traveler's Way

PERSONS traveling on railroad trains at night must pass through many unlighted places, especially in the smaller towns. One salesman lighted his way by placing a small battery in his suit-case and a light in each end. Cells of the battery were placed under each end of the hand-



The light may be used from either end of the suit-case for lighting dark places

grip, a push button extending through the leather near the handle. Connections were made from each cell to a lamp in one end of the grip near the button. It required only a push of the button to light the way.—LEON BERS.

A Tank Filler Cap and Pump Squirt-Gun

A MOTORCYCLE rider has made a useful pump and tank filler cap combined. Its body is a piece of brass tubing just large enough to fit into the hole in the tank. This is fitted into the plug used for the covering on the filling hole. Within the tube is a plunger like a hand or foot-pump.



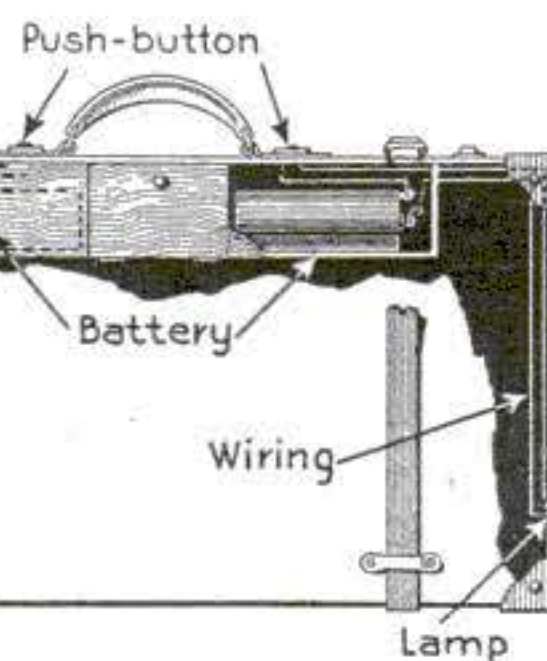
Plunger in filler cap

With this instrument it is easy to catch up a small portion of gasoline which is used for priming or for cleaning parts about the automobile engine.

The lower end being pointed like a hose nozzle, a small fine stream issues which can be used for cleaning bearings or removing dirty grease in inaccessible places. The force of the stream can be regulated by the pressure on the handle.—W. A. JONES.

Photographic Ray Filter Made of Amber-Colored Spectacles

IN photographing clouds, mountains, or distant views in strong light, very little success is possible without the use of a lens color screen. Hence I found myself in a dilemma, on a recent trip into the Yellowstone National Park, when I found that my color filter had been lost from my pocket somewhere along the road.



Location of the battery in the top of the suit-case

I chanced to have a pair of amber-colored spectacles that I use for motor-driving goggles, and, noting that the glass in these was of about the same shade as that of the color filter I had lost,

I gave them a tryout. One lens of the spectacles was held over the camera lens with the aid of a rubber band. The same exposure was given that would ordinarily have been used with the regular color screen, and perfect results were obtained.

—JOHN EDWIN HOGG.

A Rubber Tube Can Take the Place of a Water Bottle

WHEN aches and pains are to be allayed it is usually the family hot-water bottle that is called into service. A long rubber tube, however, about 1/2 in. in diameter and as long as desired, will give much better results, both in adaptability and evenness of temperature.

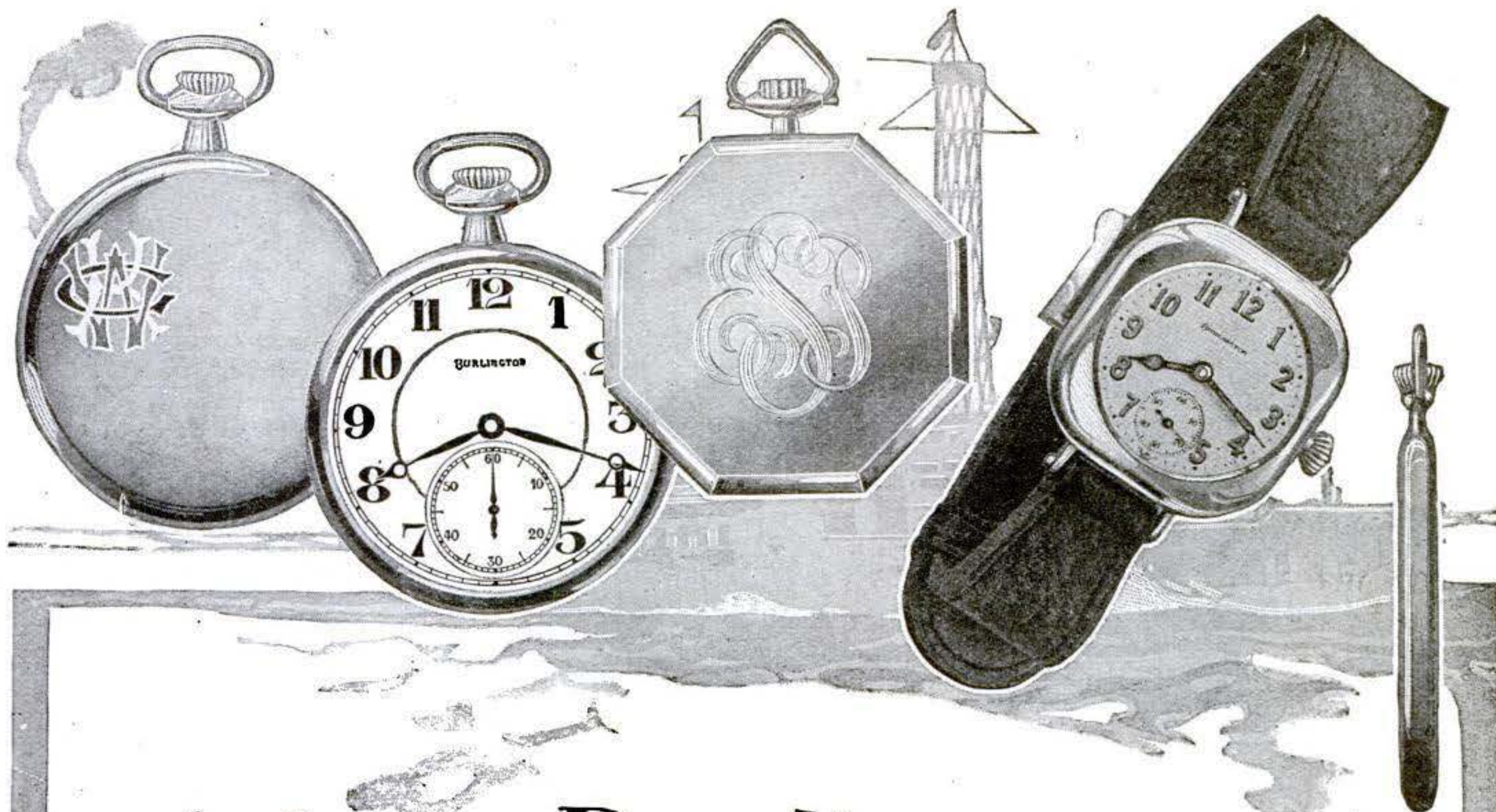
The way to use the tube is to coil it around the part to be treated, at-



The rubber tube carries the hot water to the aching limb, thence to the overflow

taching one end to a hot or cold water faucet, with the other end leading to a drain. By using the bath-tub mixing faucet the tube can be kept at any temperature and for as long as desired. If necessary, it can be kept in place by means of bandages.

—F. L. MATTER.



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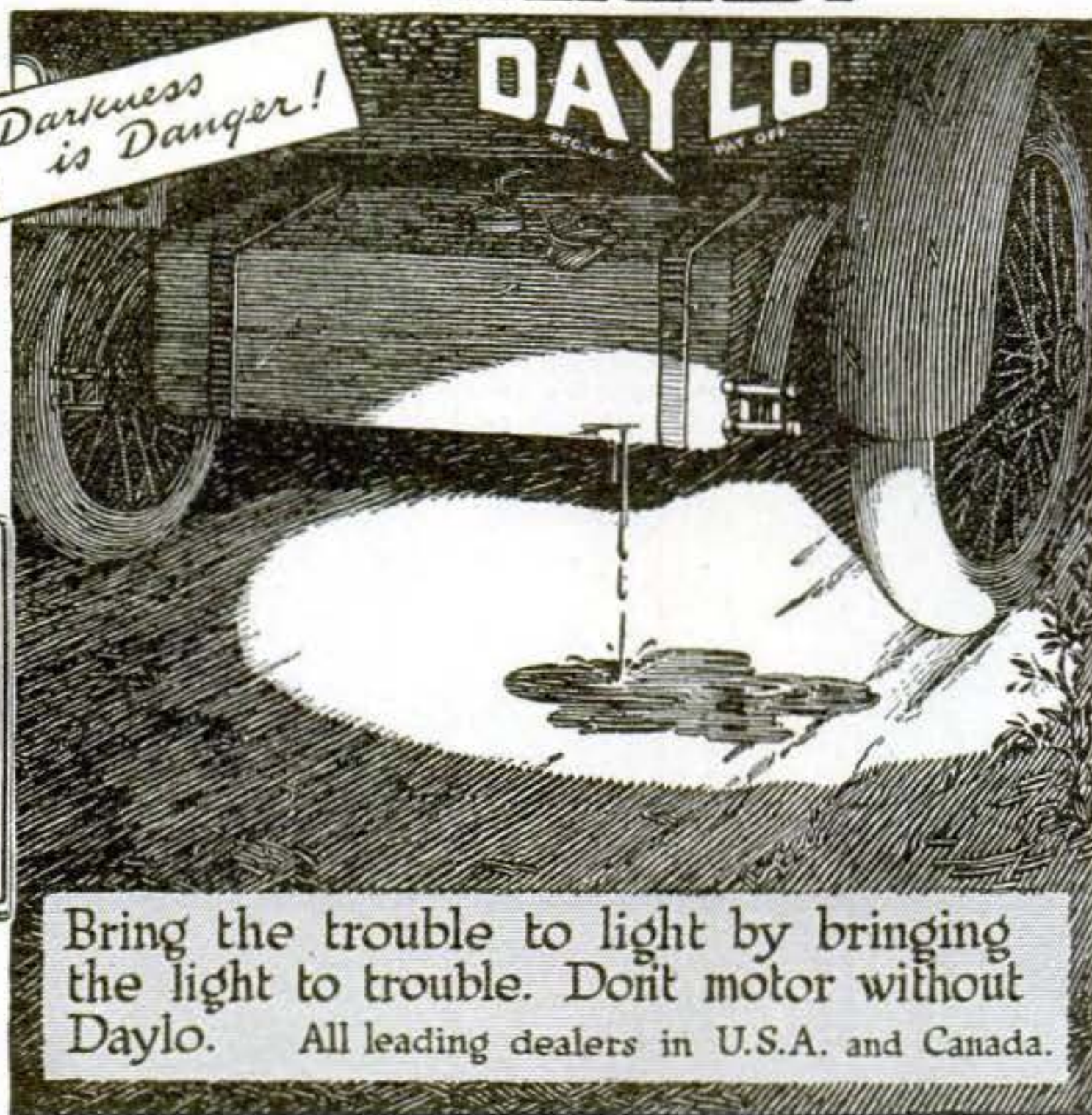
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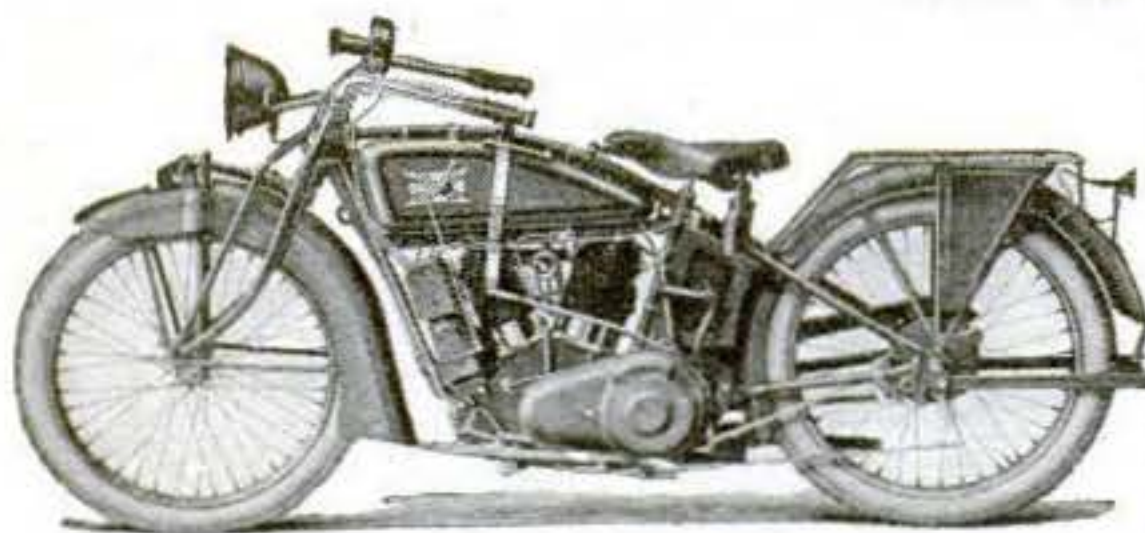
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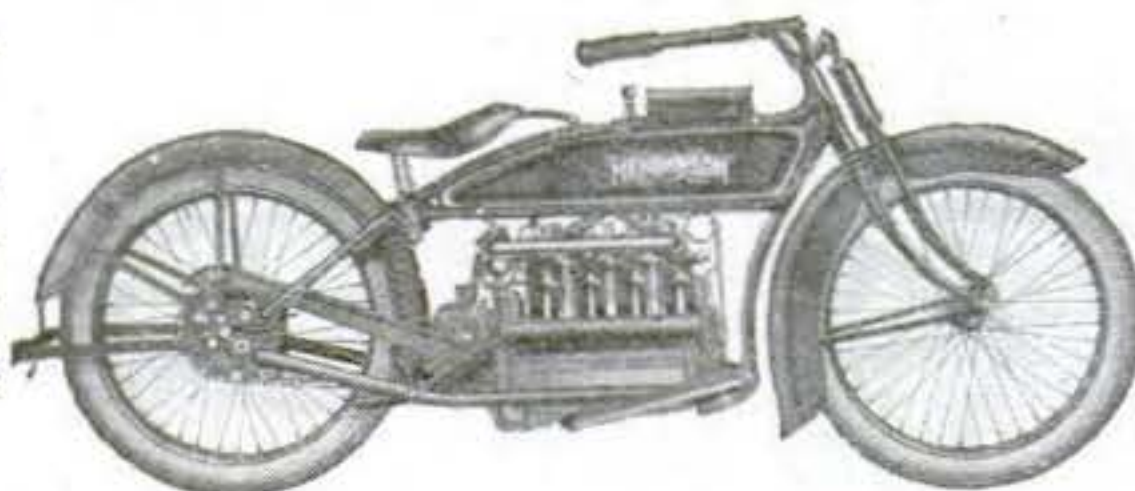
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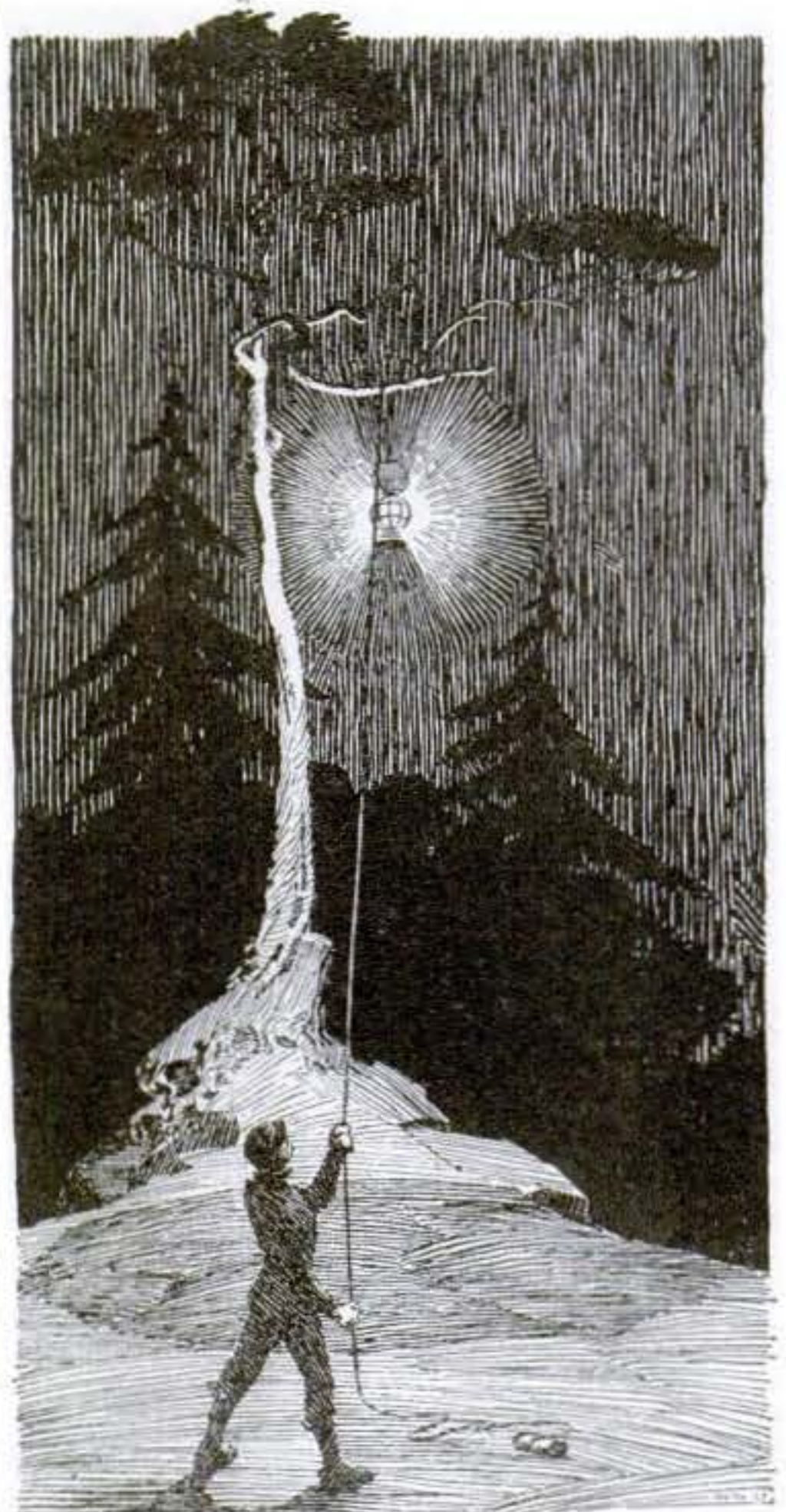
Use Transformer to Locate Short Circuit in Armatures

WHEN testing an armature with a transformer, or, as it is sometimes called, a mil, the polarity of the armature must be taken into consideration. In a two-pole armature, a single short circuit will heat up two coils; a four-pole, four coils, and so on.

A good way of locating the affected coil is to apply the receiver test. Both terminals of a telephone receiver are placed on adjacent commutator bars, which are connected with one of the affected coils, and the volume of sound transmitted to the receiver noted; the same is done to all other affected coils. A short circuit will have a greater volume of sound than a perfect coil.

Effective Night Lighting for the Boy Scouts

OFTEN when scouting or camping at night signaling is hampered by difficulties due to thick foliage and



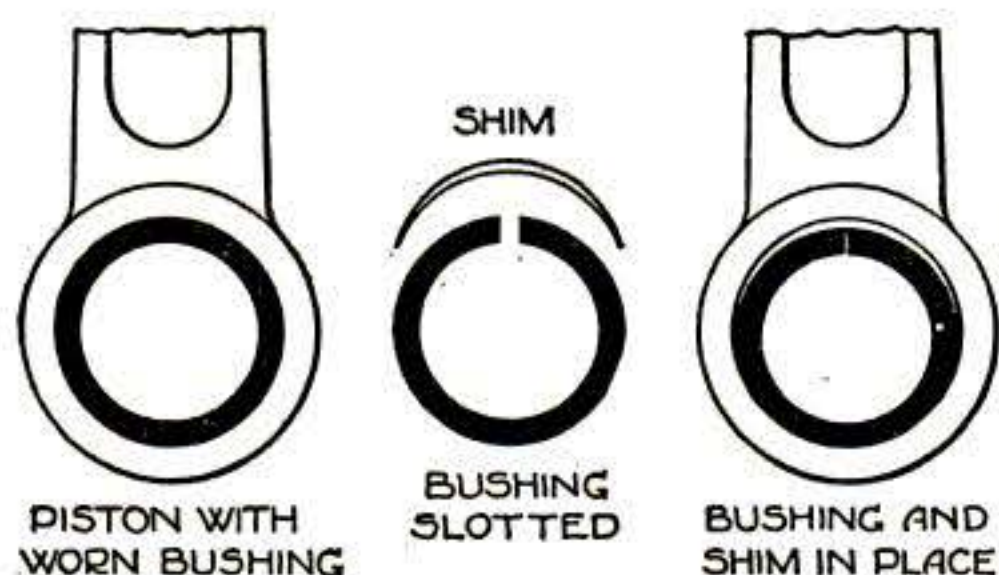
The lantern swung on a limb is raised and lowered to spell out the signals

undergrowth. However, if you are provided with a lantern and a fishing line, or any other rope or cord you can usually get your message "across."

Simply tie a stone or short heavy stick to one end of your cord and your lantern to the other end. Throw the stone over the high limb of a tall tree. Swing your light up and down for the signals. There is no time lost in climbing to work this signal.—W. B. SMITH.

Taking Up Wear in Motorcycle Engine Pitman Bearings

HAVING an early model motorcycle in which the connecting-rod bearings were badly worn and not wishing to spend money on new bearings and a crankpin, the owner devised the following repairs that served



A curved shim placed between the bronze bearing and the crank-housing

to run the machine a season after which it was still in good condition.

Each bearing was taken out, a slot cut through one side with a hacksaw, and then squeezed together. After replacing the bearing the extra space was taken up with a shim, as shown, which was soldered in place.

By this procedure permanent repairs were accomplished with ordinary tools.—ERNEST OFELDT.

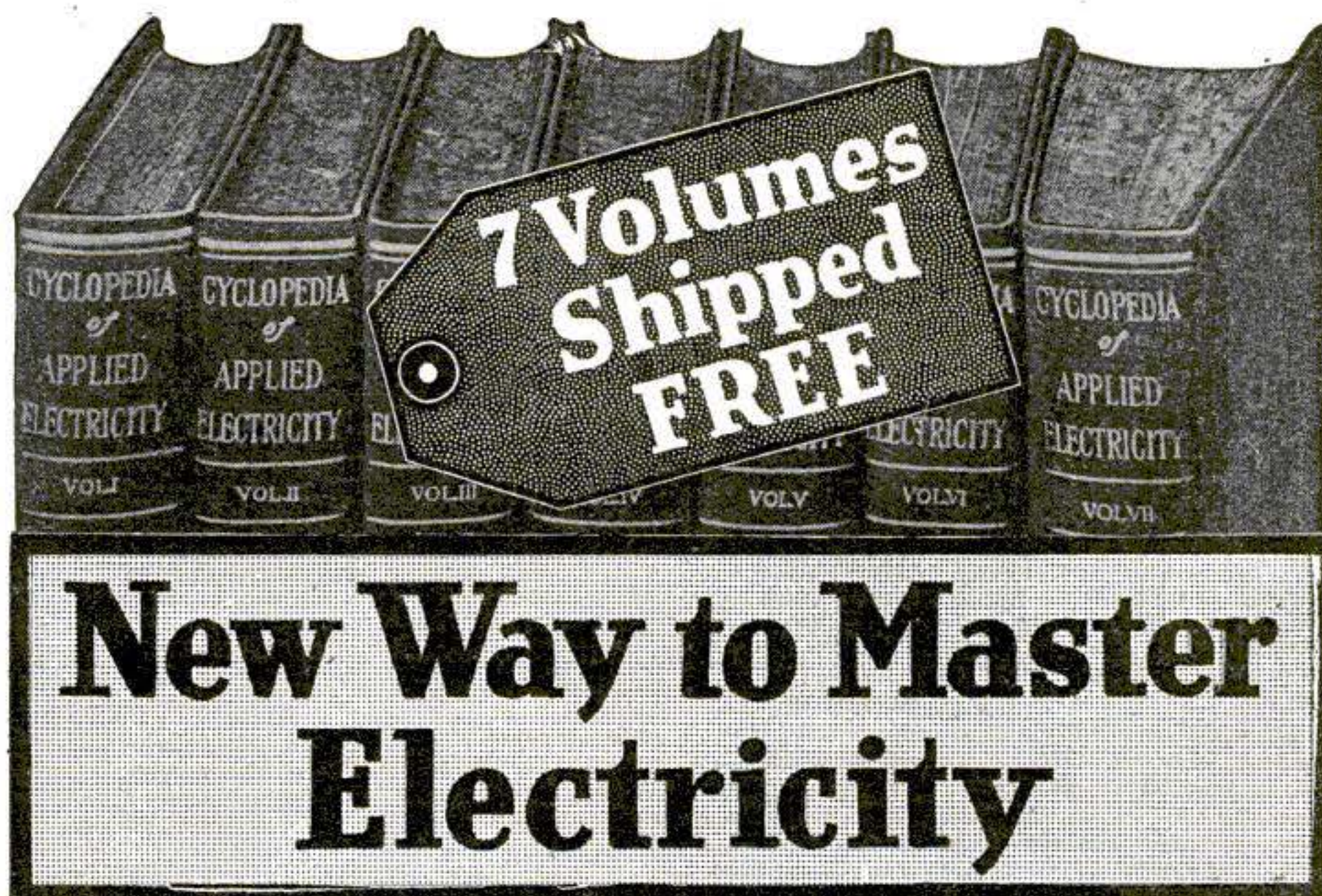
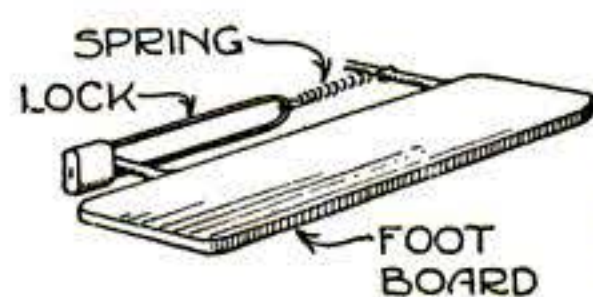
How to Figure the Quantity of Paint to Cover a Given Area

TO determine the quantity of paint required to cover a given area, measure the length and width of the building and obtain the perimeter or number of feet around the building. Multiply this by the average height and the product will be the number of square feet to be painted.

A gallon of good paint should cover three hundred square feet of surface with two coats. Divide the number of square feet to be painted by 300 and the result will be the number of gallons that will be necessary to cover the ordinary surface. A very porous, rough, or scaly surface will naturally take up more paint. If three-coat work is desired, half again as much paint will be needed.

Carrying a Lock in a Motorcycle Without Rattling

MOTORCYCLE locks are usually 8 or 9 in. long, and when not in use it is difficult to carry them without having them rattle. The illustration shows a way of carrying a lock on the footboard supports with a spring which keeps it firmly in position.—N. DRYNAN.



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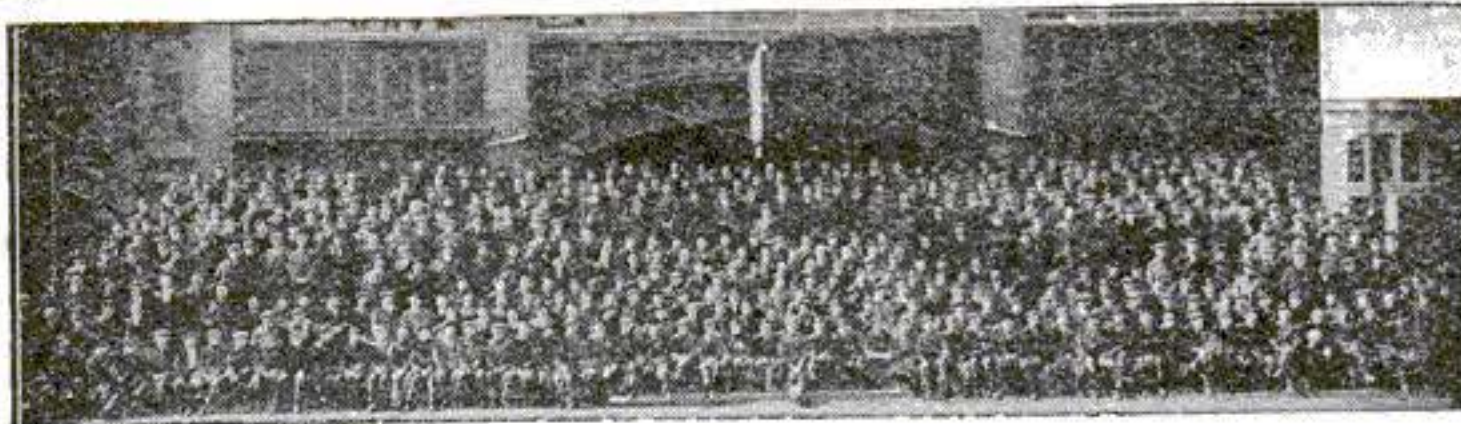
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and 8-cylinder King are used for road instruction. We have 25 motors in our block test department—2 cyl., 4 cyl., 6 cyl., 8 cyl., and 12 cyl., including Packard Twin "6" and Willys-Knight. Our electrical department is complete, having every standard starting, lighting, and ignition system, including Leico System as used in Buick, Hudson, and Packard Twin "6." Students get actual experience in handling all kinds of electrical auto equipment and taking care of trouble. We have a Sprague Electric Dynamometer for block-testing purposes for students' use. Ours is the only Auto school having this equipment. School open all year. Enter classes any time, any day. Three classes daily: morning, afternoon, evening. All instructors are members of the Society of Automotive Engineers (S.A.E.)

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YOUNG MEN WHO REGISTERED JUNE 5th You May Not Be Drafted for Months—Prepare NOW!

You may be drafted very soon, but chances are that you won't be for three months, perhaps six months. In the meantime prepare to serve your country better as a trained man. Train to be a motor repair man, aeroplane motor mechanic, truck driver, welder, tire repair man, etc. We can teach you thoroughly in from eight to twelve weeks.

Young Men Under 21

About half of recent enrollments in this school have been young men under twenty-one. They are training themselves now, so that when they become twenty-one and are drafted they will be in line for something different than trench duty. By being trained men they will receive nearly double the pay. Even though you may never be drafted you will be qualified as a trained man, to take the places in the factories, garages and service stations of mechanics who have already joined the service. The Board of Commerce says there is a shortage of trained mechanics in Detroit alone of 35,000. Prepare now for one of these good positions and be ready to serve your country where you are most needed.

Men Over Draft Age

The draft age limit may be raised. Prepare now to serve as a trained man in case it is raised. Prepare now to take the places in factories of the trained men who have already been drafted. Detroit alone has 35,000 positions open for trained men. Trained mechanics are just as necessary to win this war as are the men in the trenches.

Money-Back Guarantee

We guarantee to qualify you for a position as chauffeur, repair man, tester, demonstrator, auto electrician, garage man, automobile dealer, Aeroplane motor mechanic or tractor mechanic and operator, paying from \$75 to \$300 monthly or refund your money.



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A. G. Zeller, Pres.



Parents, Train Your Sons NOW

Give your sons this training so that they can fill the places of the mechanics who have already left the factories. As trained mechanics they serve their country best, and certainly are equipped for a money-making business after the war.

Tuition Refunded if You Are Drafted

In case you are drafted within ten weeks of the time you start the complete automobile course, and before you finish the instructions, we will refund your tuition in full. Many of our graduates are now in the motor service. Think this over, and train yourself while you still have a chance.

Women Take Courses

Many ladies have taken our course and are making good. They are holding good positions and are completely satisfied with our instructions and the courteous treatment accorded them. They receive the same work as given to men. They can enter classes any day.

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The Michigan State Auto School grows bigger and better every day. Every person connected with the school is alert always. All are studying the automobile, truck, tractor, aeroplane, tire and welding conditions and are adding, progressing and improving constantly. Our students, trained in Detroit, "The Heart of the Automobile Industry," under the most favorable conditions, are in greatest demand everywhere. Our school is known favorably all around the world. We train both the head and the hand in a thorough, practical, complete way. The different courses are intensely interesting from start to finish. There are no dull moments.

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A Tool-Box Cover that Is Convertible into a Bench

ANY ordinary tool-box having a flat-topped lid can easily be made convertible into a serviceable table in the manner shown below.

All that is necessary are four wooden legs of triangular cross-section and eight small cleats. The hinges, of



The posts of this bench may be carried in the tool-box which serves for the top

course, must be of the loose-pin variety to permit the lid being readily taken off.

The four legs are ripped out of stock 2 in. square. The cleats are made of a $\frac{3}{4}$ by 1-in. strip. They are shaped to make a fairly tight fit for the ends of the legs, and one is glued and screwed into each corner of the cover and the box proper.

All four legs, when taken down, fold into a space less than 2 by 4 in., and their length makes them suitable to be carried in any tool-box. Their weight, if made from some light wood, is very small.

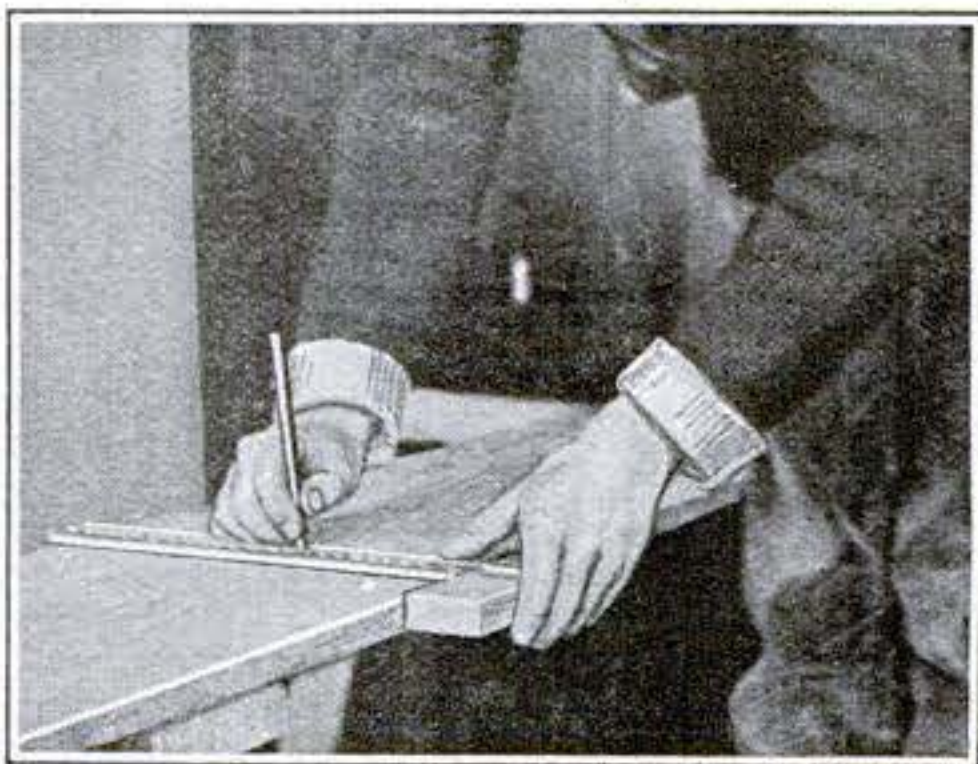
Where it is essential that a tool-box having this feature be capable of being tightly locked, this can be had in spite of the loose-pin hinges by replacing the pins coming with the hinges by pins made from spikes and having a $\frac{3}{4}$ -in. bent-over portion which is caught and clutched between the lid and box when the lid is down. A small socket must be formed, of course, for this end to lodge in.

On account of the bracing effect attained by this arrangement, such a table is rigid in spite of the fact that the various parts are only stuck together, while, on the other hand, the box can at the same time be used to hold the tools.

Such an arrangement makes it quite handy for the jobbing carpenter who does most of his work right on the job. The bench can be set up anywhere and is ready for use almost instantly. The tools are readily obtainable while at work.

A Marking Tool or Gage Made on a T-Square

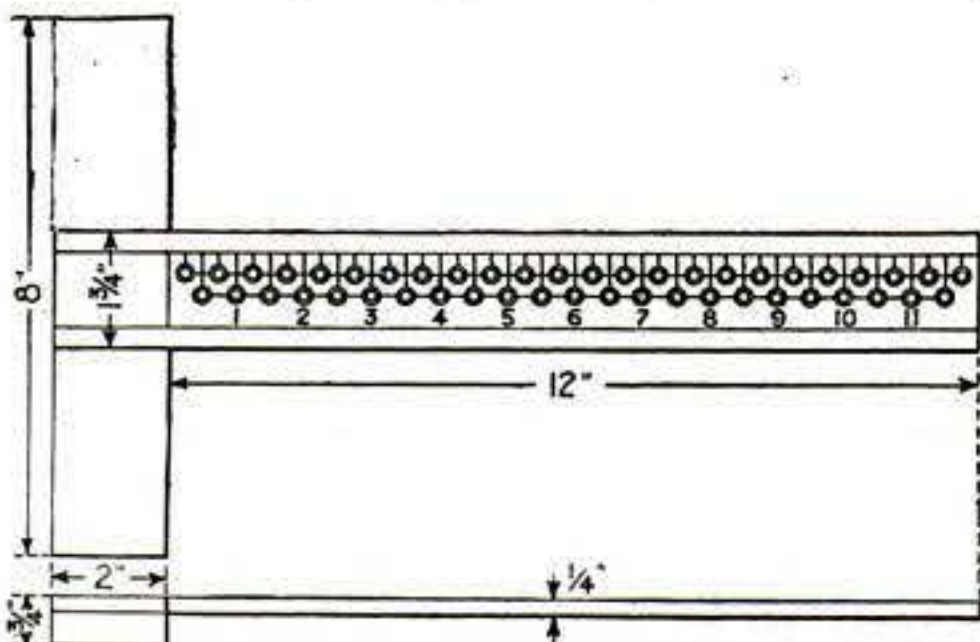
THE marking tool pictured in the accompanying photograph and drawing has been found a big help to manual training pupils when marking



The T-Square as it is used with a pencil for a marking gage on a board

out lumber at the sawhorses. It is possible that other woodworkers may find it equally useful. It consists of a stoutly built T-square, in the blade of which a common 12-in. ruler is inlaid. After the glue has set, $\frac{1}{8}$ -in. holes are drilled $\frac{1}{4}$ in. apart through both blade and ruler. These holes are afterward countersunk, as shown, to permit the use of a rather dull pencil.

By means of this contrivance, lines, either parallel with the edge of the board, or at right angles to it, may be easily drawn. Of course, instead of inlaying the ruler in the blade of the square, the figures and graduations may be marked on it. This, however, is a longer process, more liable to error,

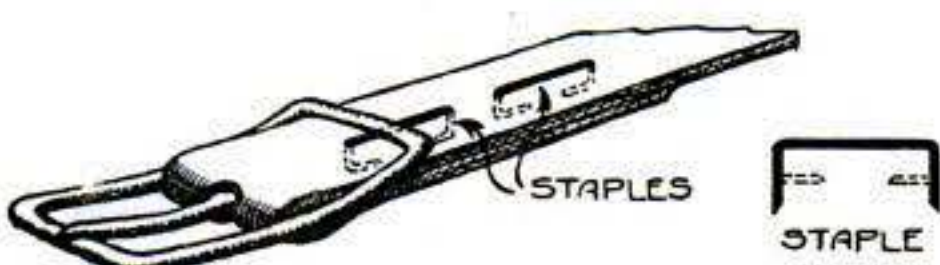


Holes drilled through the T-square blade on division marks of a ruler

and the markings are not so distinctive, or so easily understood by the younger pupils, perhaps because they have become used to the ruler in their other studies.—EDWARD H. CRUSSELL.

Fastening a Leather Belt Buckle on a Stapling Machine

INSTEAD of using a needle and thread to sew a buckle on his belt a printer ran the belt through the wire



Staples from a stapling machine used instead of stitches to fasten buckle on belt

stapling machine and did a very neat job with a few staples. What a genius a printer must be!

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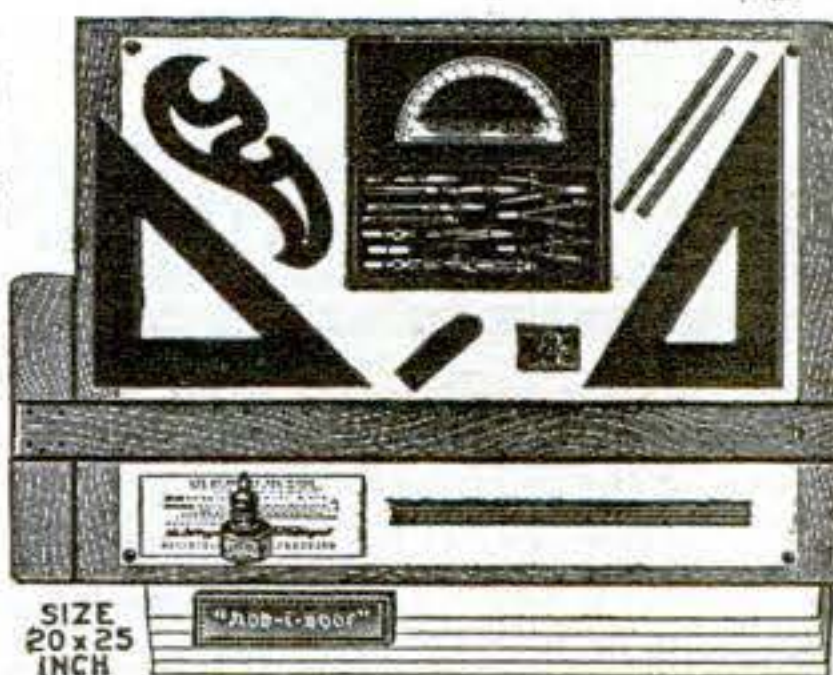
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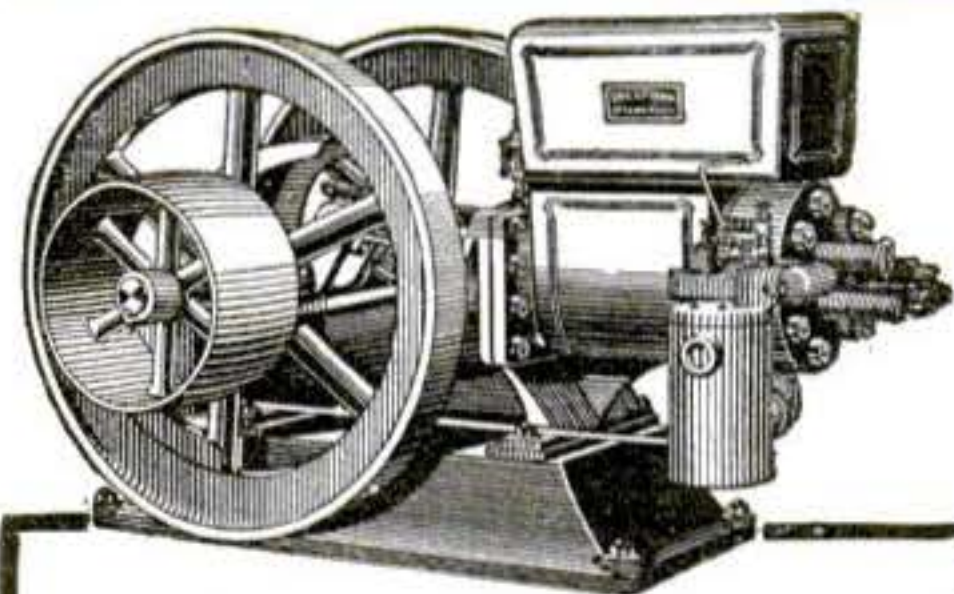
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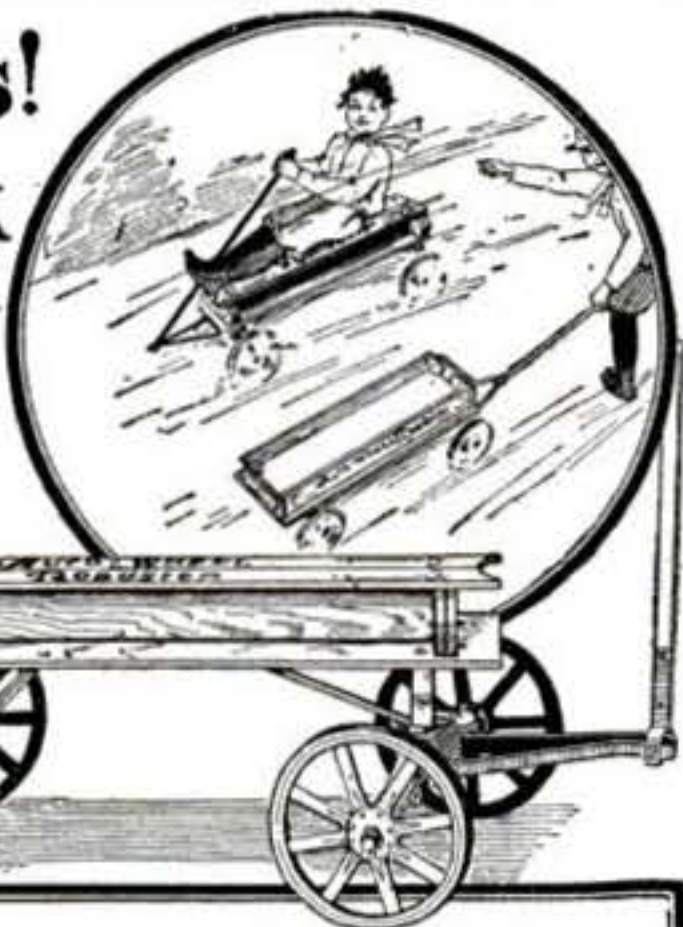
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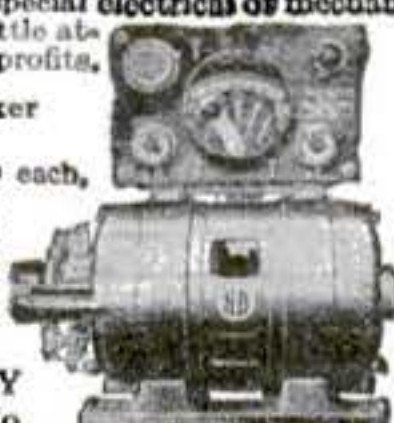


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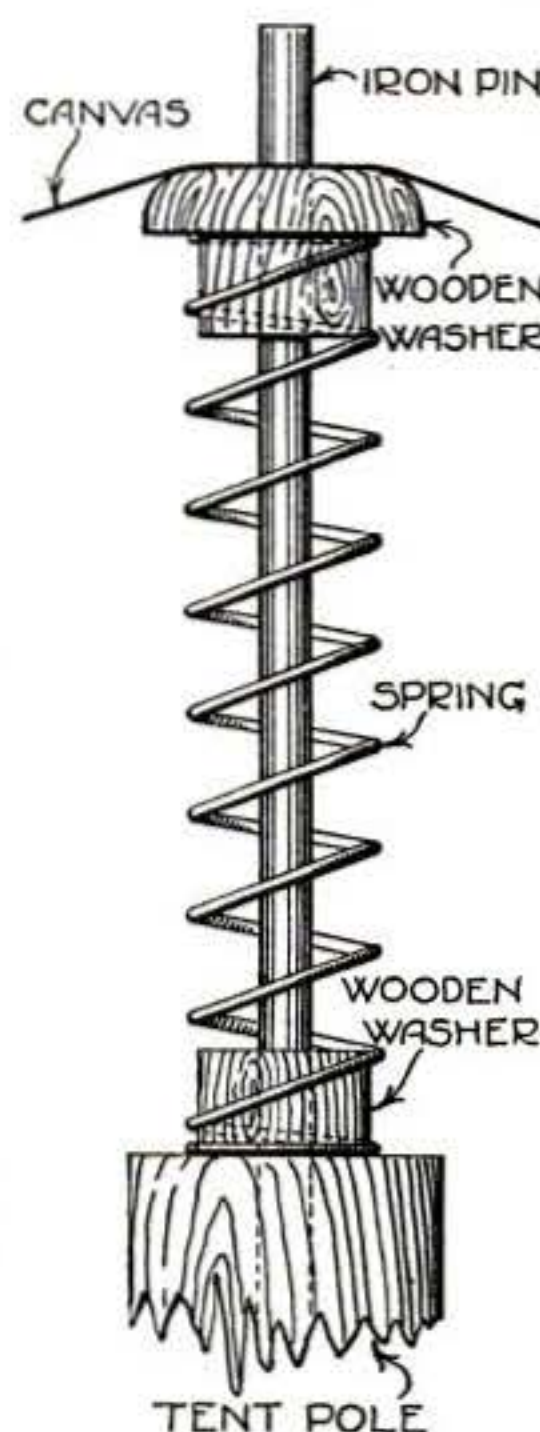
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Spring on Tent-Pole to Keep the Canvas Tight

CANVAS or cloth used on tents will change with the weather conditions, and when a tent is set the cloth will soon bag or stretch so tight that it will draw the stakes.

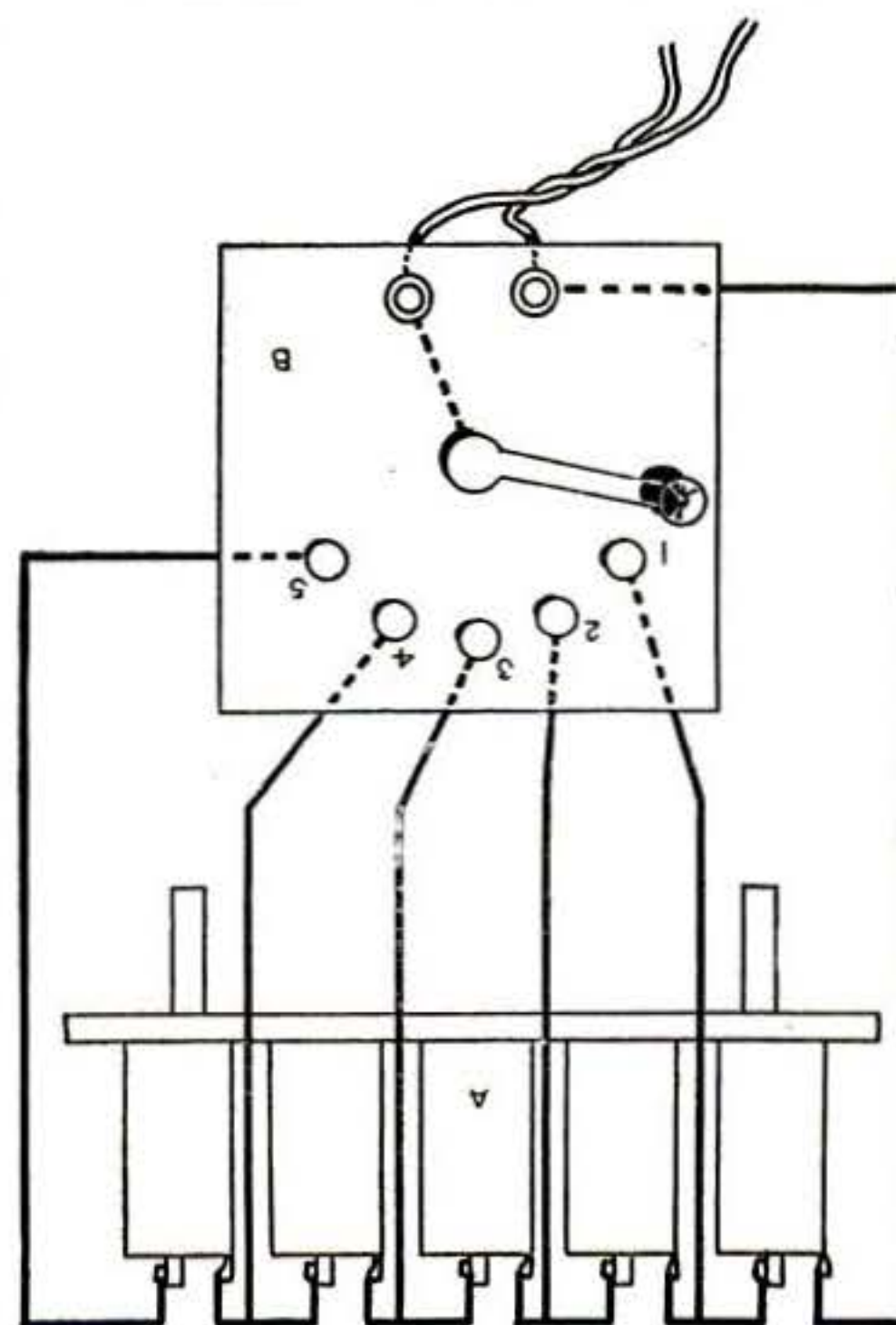


A coil-spring on a tent-pole end

With the spring attachment for the upper end of the tent-poles, as shown in the illustration, this difficulty is overcome. The coil-spring takes up the shrinkage or expansion of the cloth and keeps it to a certain degree of tightness at all times. The iron pin should be firmly set into the pole, and as a precaution to prevent the wood splitting a ring band may be fitted on just below the spring end.—G. A. QUIN.

A Controller for Batteries in Electrical Experiments

WHEN conducting an electrical experiment it was found very annoying to stop in the middle of it for the purpose of connecting or dis-



Switch and its wiring diagram to make a controller for battery cells

connecting an extra battery. After a few experiences of that sort it was decided to connect a series of batteries in such a way that the number of batteries could be instantly increased

or decreased. The illustration shows clearly how this was done.

The batteries, A, are placed on a shelf out of the way. From them the wires are run to a point switch, B, which has two binding posts on it for connections to the work. At C is shown the manner of putting the points and switch on the base. The switch base consists of a block of wood. The points are round head bolts and the switch a strip of brass. The handle is made of a black knob taken from a tin pot cover.—ALBERT E. JONES.

A Horse-Shoer's Box for a Tire Service Station

WHILE in a service station, I noticed that the owner equipped each service man with a tool box, built something along the lines of the



The regular blacksmith's tool-box makes a very convenient tool receptacle for the garage man

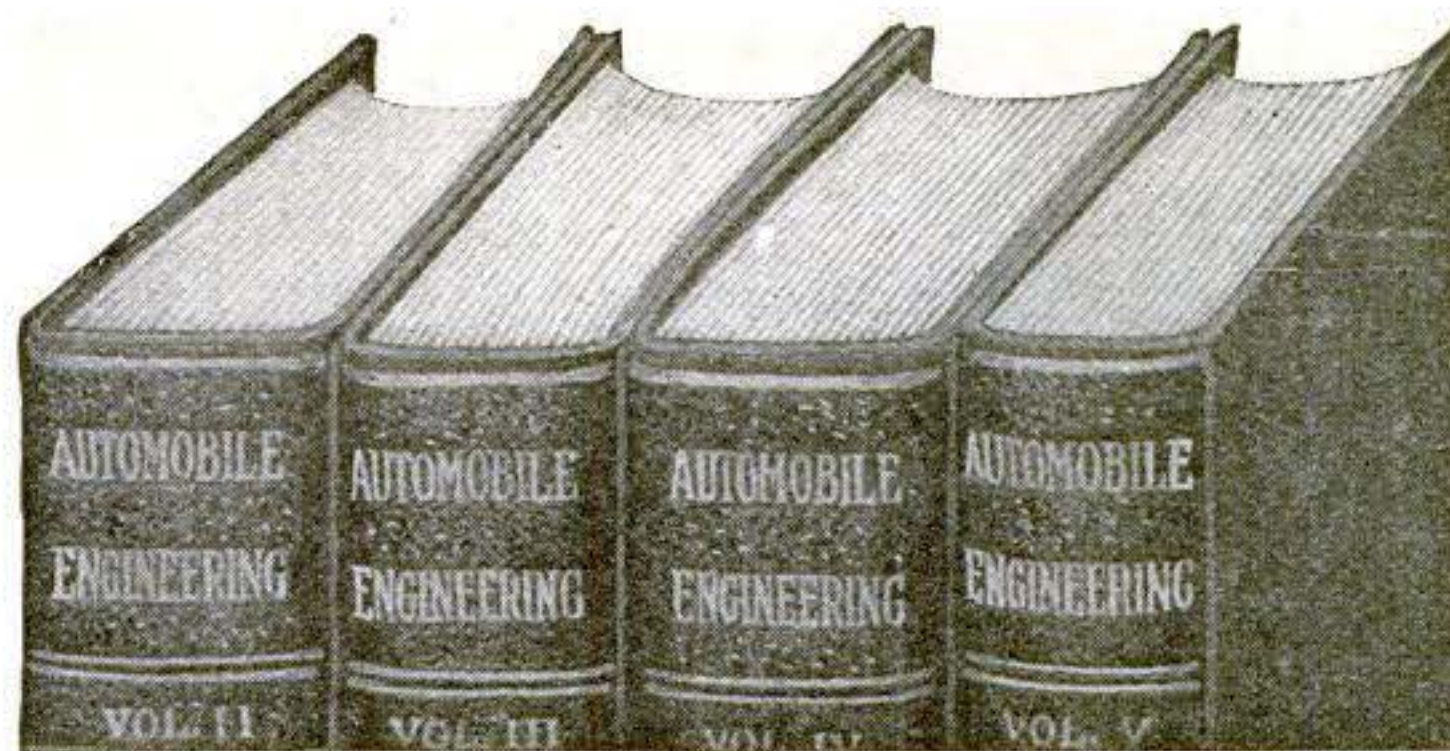
horse-shoer's box. Each man is obliged to keep his own tools in his own box and is held responsible for them.

This plan enables the station to give better service, and does away with the hunting for tools. Before these boxes were installed five or more minutes were lost waiting for the service man to return with tools he left around the station.—F. JACOBS.

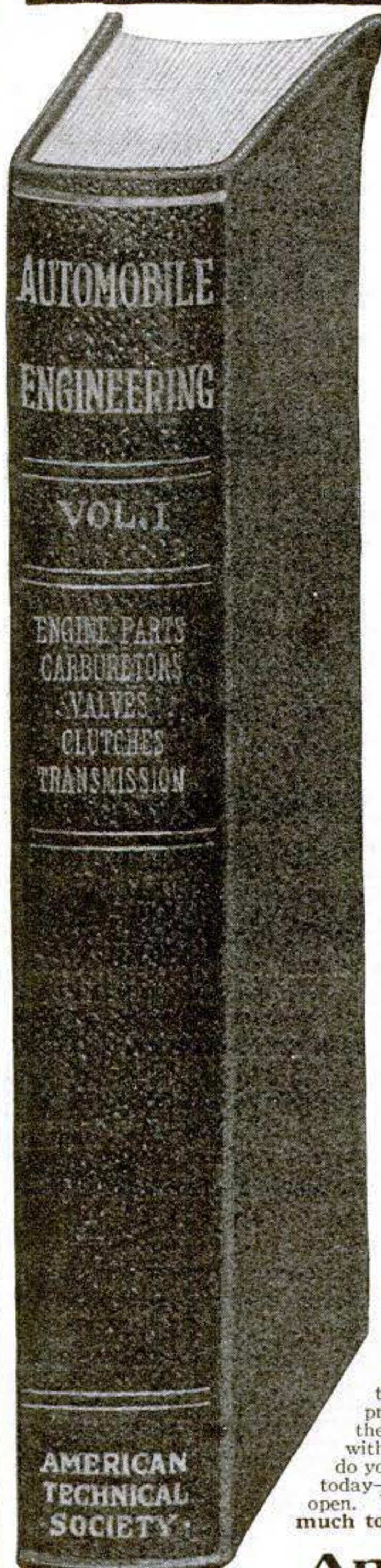
Tire Casings Riveted Together to Prevent Side-Slipping

SOMETIMES an autoist will try to lengthen the life of an already worn-out shoe by slipping an old oversize shoe over it as shown in the illustration, gaining the advantage of the two thicknesses of rubber and fabric. The outer shoe often slips out of place or bulges out of place because of its being too large for the wheel rim.

This result was overcome by one man in the manner illustrated. He cut the clinchers off the original shoe, which allowed the outside one to fit snugly against it. Then he clinched them together with a row of copper rivets around both sides. The rivets were put about 6 in. apart. This arrangement has been in use for over 1000 miles without a sign of slipping or possible bad effect.—L. B. ROBBINS.



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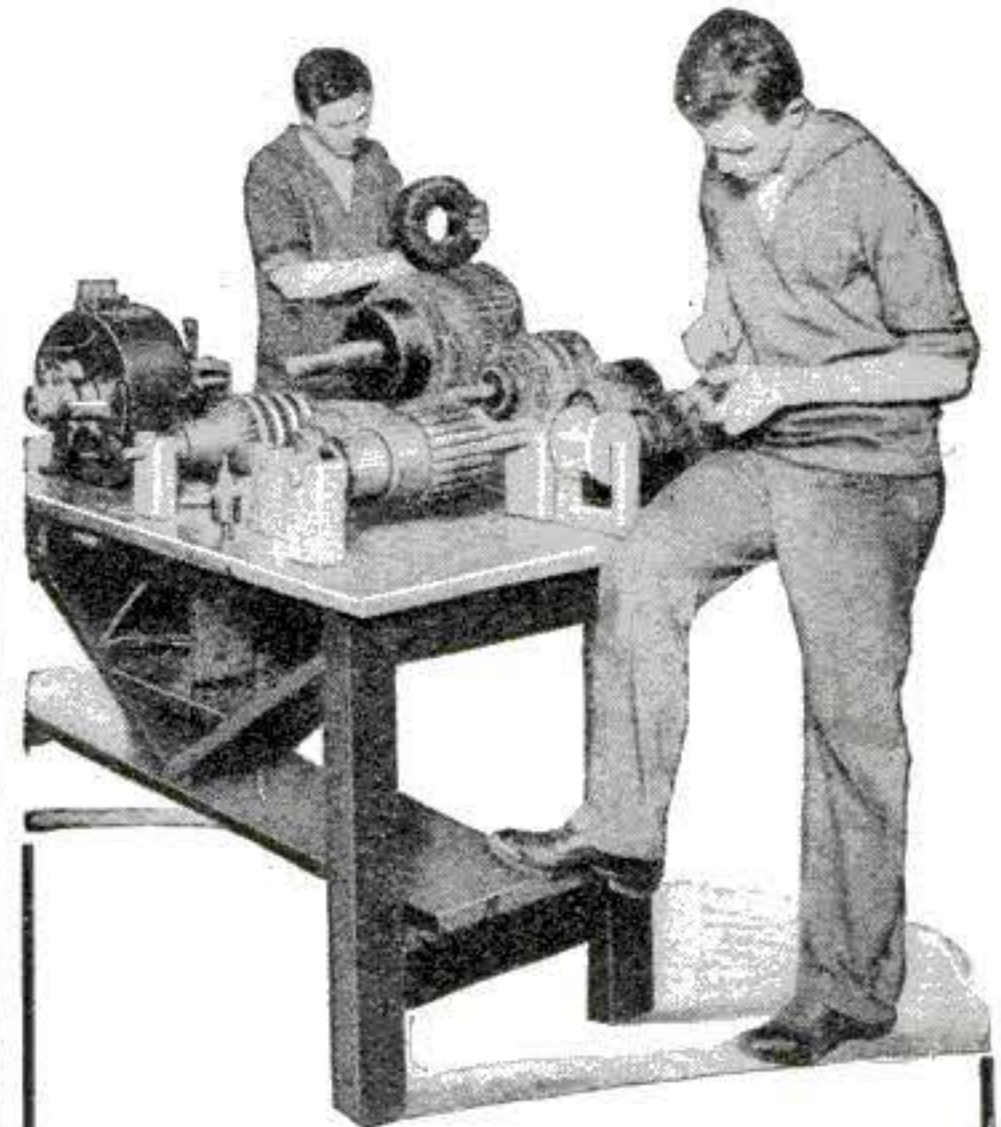
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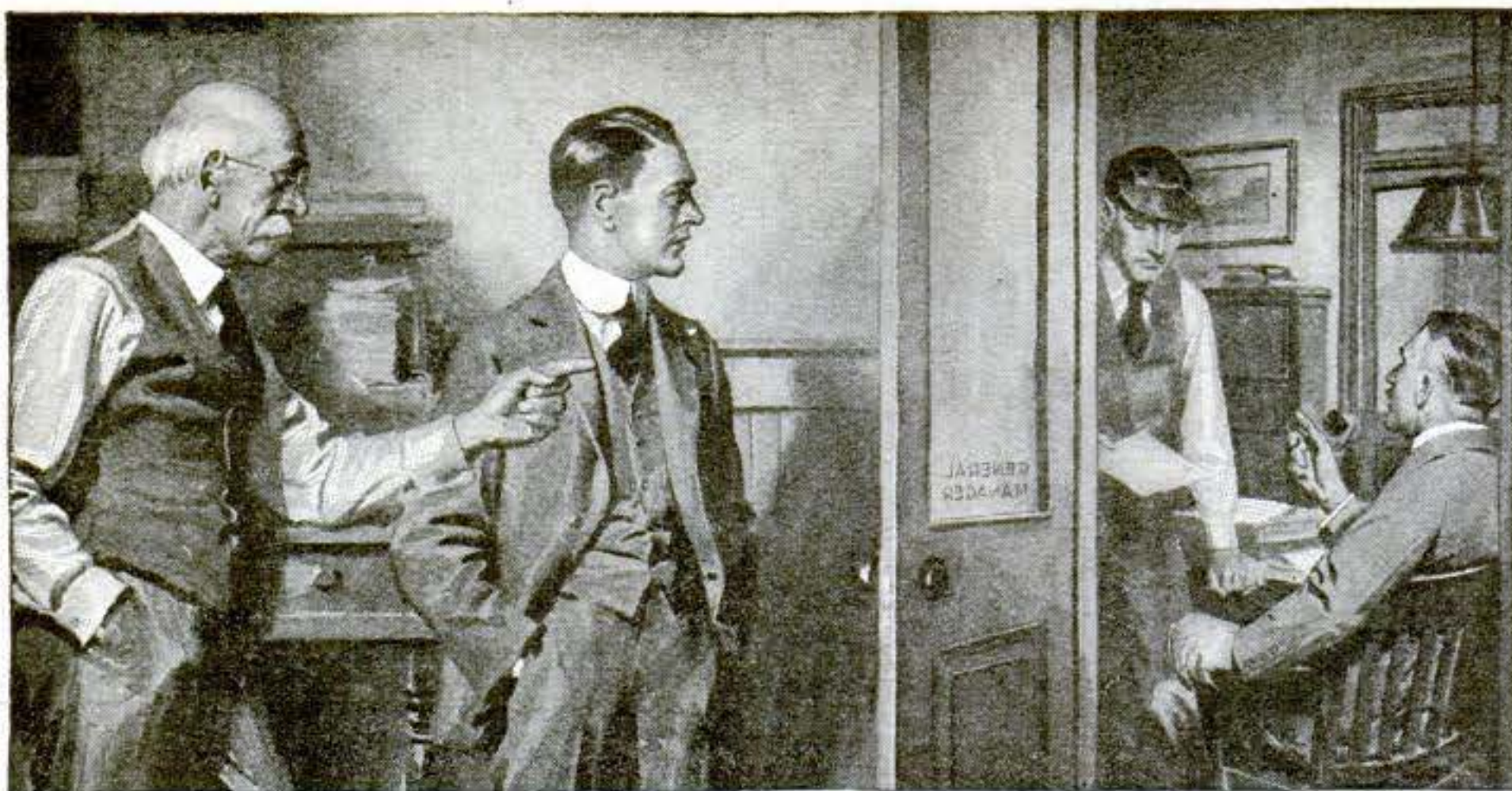
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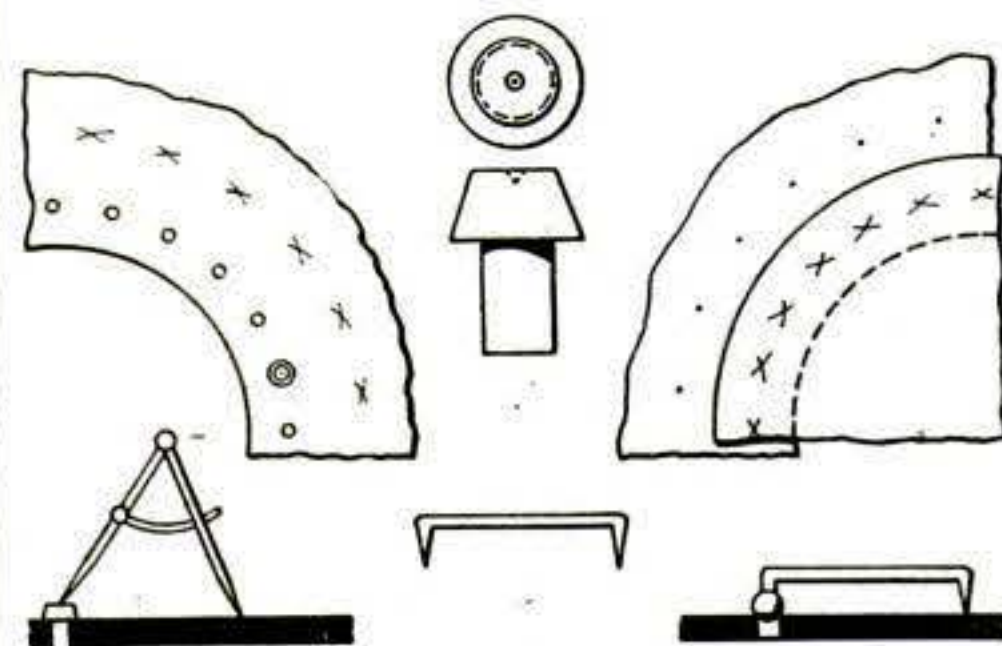
To Detect the Presence of Aniline in a Pigment

A LITTLE of the color is laid upon a piece of letter paper, and a drop of spirit poured upon it. If the pigment contains an aniline dye, the paper will be colored right through by it, while a pure pigment will not alter the shade of the paper and will under no circumstances penetrate it.

Transferring Marks for Drilling Holes in Difficult Places

IT is often found necessary to transfer measurements of old holes to a new piece; but—due to some impossibility of measurement, such as blind holes, or difficulty of access with a scribe or other marking instrument, or the fact that the holes follow some diverting course—difficulty is often experienced in the transferring of measurements.

A simple as well as fairly accurate method of transferring measurements is to use a rivet having a center punch mark exactly in the center of the head, and a body that will fit snugly into the holes that are to be transferred. A pair of dividers is then used in conjunction with this rivet, and arcs are



A rivet with center mark or a ball end on a special marking tool

struck at any convenient distance from the holes so that they intersect one another. Center punch marks are then made at the points of intersection of the arcs.

It is well to mark the distance of the stretch of the dividers on some conspicuous part of the metal, and center the marks before going farther, as it will be impossible to recover the distance of the stretch of the arc radius, after the part to be marked is placed in position.

A template, or the part to be marked, is then placed in position over the holes. One leg of the dividers is then placed in the center-marked intersections of the arcs, care being taken that the stretch of the dividers is exactly the same as before, and the striking of arcs is begun on the piece to be marked. After all the arcs are struck, the points of intersection are centered and the holes are drilled, these corresponding with the holes in the old piece. When the part to be marked is of thin metal a greater accuracy is acquired by grinding the rivet down to the thickness of the piece to be marked.

In shops where there is a great amount of this sort of work to be done it is well to have a few special marking tools made, as greater accuracy as well as faster time is made. This tool is merely a piece of tool steel bent at right angles on each end, one end being spherical and placed into the holes and the other end terminating in a sharp point for marking.

Another tool is used in conjunction with the above, which has two sharply pointed ends, bent at right angles to the body, with exactly the same distance between the two points as the distance between the center of the sphere and the point of the other. In the making of these tools, the thickness of the part to be marked must be taken into consideration.

To Test the Movement of Sliding Parts of Machinery

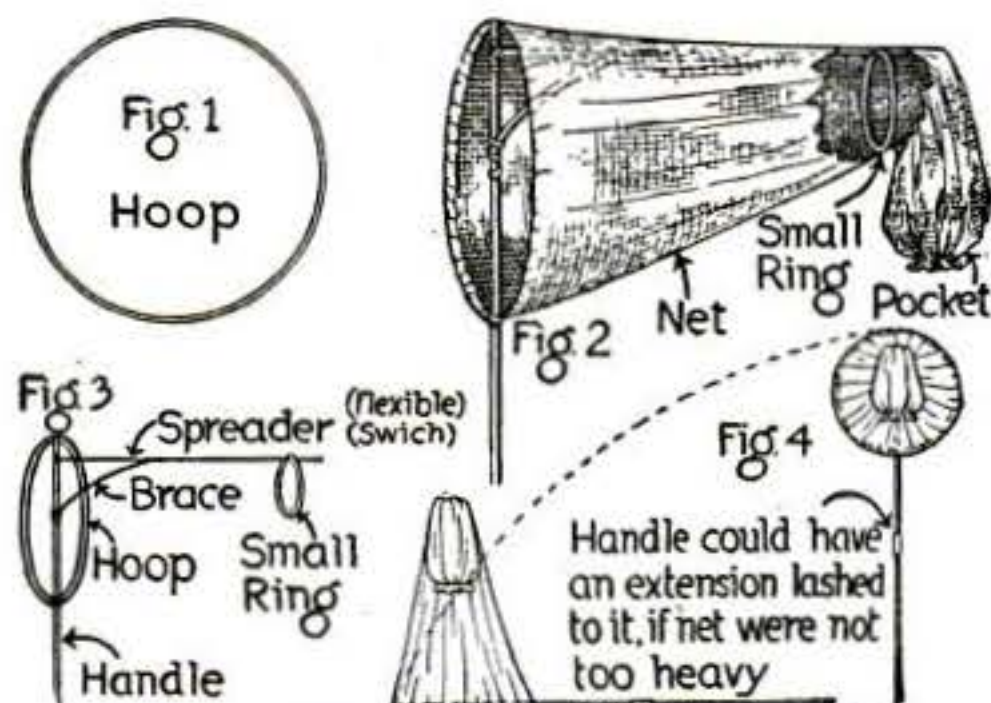
IF movement is suspected between slides or other parts of machinery as a result of the application of pressure, run a very little kerosene in between the joints. The very slightest movement is evidenced by the sucking in of the oil as the surfaces separate, and its expulsion as they move together.

Looking so as to catch the light on the surface of the fluid makes this test exceedingly delicate.—H. J. GRAY.

Catching Sparrows on Ivy with the Use of a Net

WE were very successful in netting sparrows at night from the ivy on the house, using a net built as shown. The large hoop is iron wire about 3 ft. in diameter lashed to a handle. The net is made of thin calico, with a depending pocket at the end, the pocket being kept open by a small hoop secured to the wooden spreader which in turn is lashed to the handle and supported by a brace. The pocket is made of fly netting so that the birds may see a spot of light to fly at through the small ring.

The net was placed against the ivy



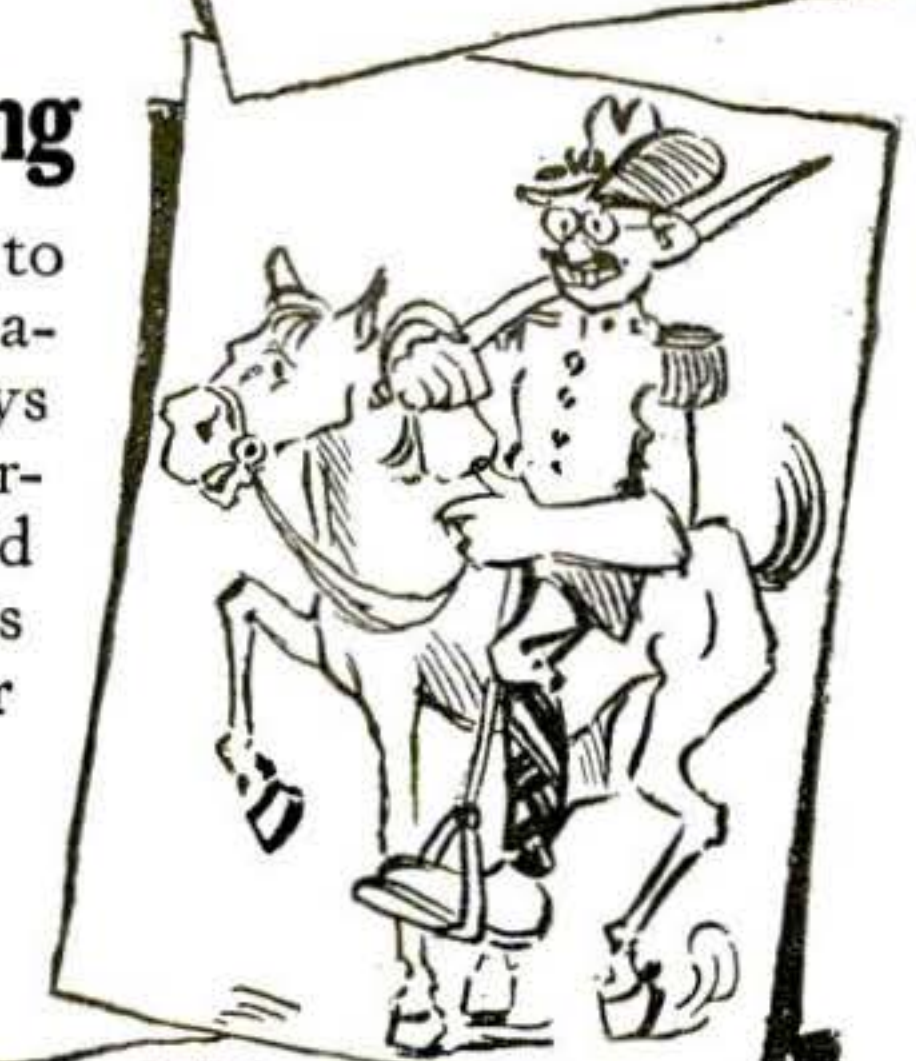
Hoop with bag like a naturalist's butterfly-catcher, to trap sparrows

as high as possible and swept downwards in an arc, bringing it face down to the ground. The birds were removed through an opening in the pocket and the stray ones searched for by feeling the outer surface of the net.—JAMES M. KANE.

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The Classified Advertisements are on pages 112-115. Turn to them now and learn what rare opportunities are presented for legitimate and mutually profitable business.



MECHANICAL HALLOWEEN PRANKS

By Charles M. Miller

SO many people, when they don their memory caps, associate the removal of gates from their proper hinges, the transportation of signposts to ridiculous settings, and the placing in peculiar positions of wagons and carts and plows (astride the barn roof, etc.) as the regular variety of Halloween sport. It used to be so, and while some of it was funny, if nothing was destroyed, it was too often of a hoodlum character and proved a real annoyance. A little of this has held over to the present day, but in general, the trend is toward more genteel manners and kindly frolics. This has given rise to an increase in real pleasure to a great number of people; and why not?

The congregating of agreeable young people on this occasion is a great friendship asset. Young people's organizations make merry to good advantage, and some of the older ones are not adverse to joining in at times.

Lanterns

Appropriate illumination may be worked out with home-made and Chinese lanterns hung on porches from trees and on lines from the house to trees, or from tree to tree. The old pumpkin head is still a factor of the Halloween celebration. Cat head, owl, and Japanese hideous faces all add to the creepy feeling of the evening. Good lanterns with beautiful geometric and architectural designs, also hideous faces, can be made of cardboard packing boxes, or hollow forms can be folded up into required shapes. The square shapes, as in Fig. 1, are the most practical and most easily decorated. In Fig. 2 is shown a plan for the construction of the form of Fig. 1. The flaps at the upper part serve to stiffen the top and the ends of the flaps overlap each other. The lower flaps secure the bottom in place. The lantern may be pasted, glued or fastened together with paper fasteners,

Fig.1

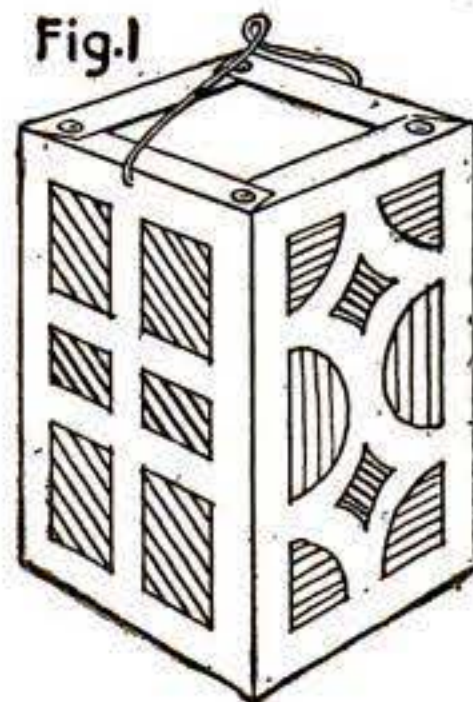


Fig.2

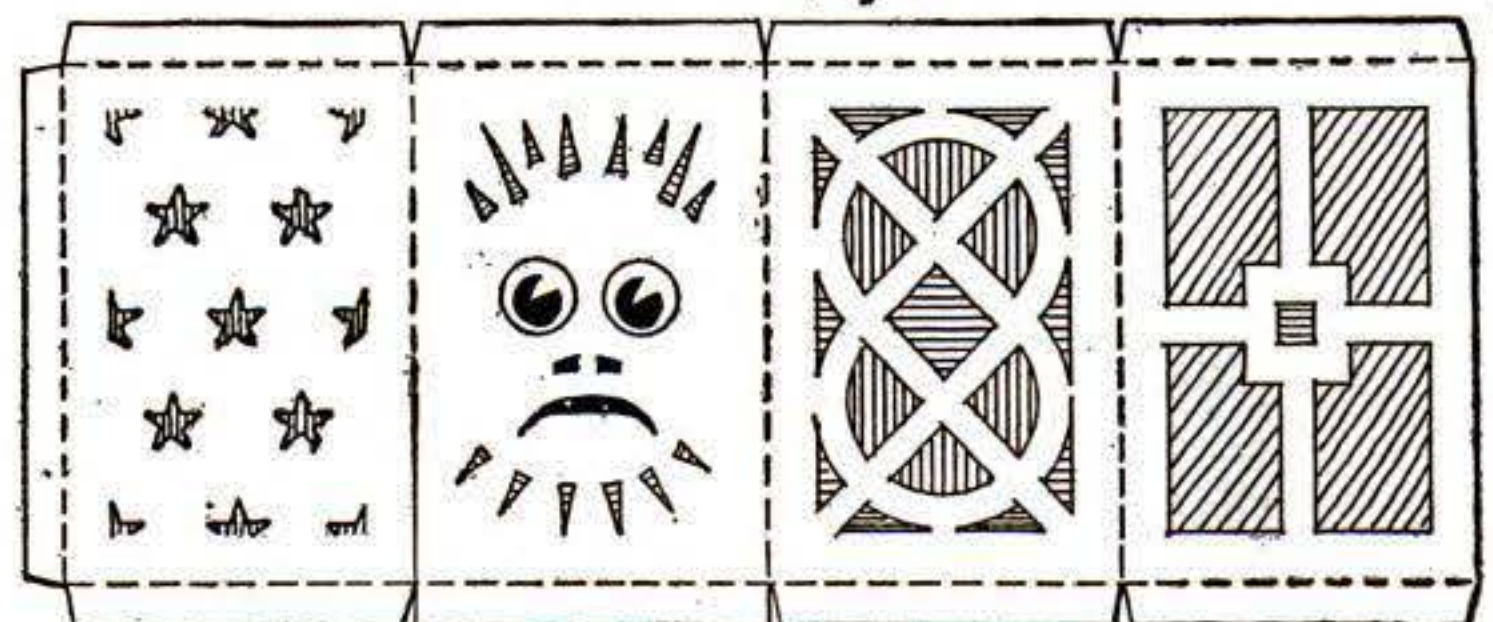


Fig.3

Green
Red
Orange



Fig.4

A square-shaped lantern and the pattern for cutting the sides from the cardboard in one piece, the knife for cutting the cardboard, and the candle-holder

according to the thickness of the paper or cardboard used. The openings should be cut before the lantern is fastened together, a paring knife or regular cardboard knife is good for cutting, as the point will go well into the corners. In Fig. 3 is shown the cardboard knife. It will be best to paste the colored semi-transparent paper on before folding it. If tissue paper is used the paste should be put on the frame and the tissue then pressed down on the surface. Care should be taken in handling the tissue as it tears easily when wet. If opaque portions are to be pasted to the tissue for a design they should receive the paste. Green, red and orange are about the best colors for lanterns. In one of the illustrations a hat box is shown which was made into a lantern, the design being taken from a cathedral window. A candle holder can be made of wire bent in the shape shown in Fig. 4. Put prongs through from the underside and paste or glue a small piece of cardboard over the loop portion. If the lantern is placed on a table the candle can be pressed down on the points. A little sand in the bottom will go far to prevent destruction by fire. A light wire bail is attached to the top portion. A number of lanterns should be planned and made some time before the celebration night so as to have an ample supply.

Window Posters

A kind of illumination that is quite similar to the lantern decoration is the mounting of opaque pictures on semi-transparent backgrounds, which in turn are mounted on heavy paper with some kind of rectangular, circular or elliptical penetrations, the whole thing being fastened to the window sash. From the outside the design shows up by the lights within the house. Another illustration shows a good-sized window design of a witch. The body is made of black paper and the tissue of green. The gray building paper was used for the outside portion. The vertical stripe should be avoided by using a larger transparency sheet or by less lapping. The doubling up of tissue paper shows more on the plate than when illuminated, but overlapping should be reduced to a minimum. The reason that the doubling is not so pronounced when in service is that the color helps out the design and a little increase of a light color is not so conspicuous. If the window is not too large the tissue paper may cover the whole sash and the opaque objects placed accordingly. Other designs are shown in Fig. 5, some of which may also be used on a smaller scale for lanterns.

The Witches' Caldron

A witches' caldron is a good setting piece for outdoors. Three sticks are lashed together for the tripod. Three laths will do if round sticks are not convenient. A kettle should be hung

Make Your Mind a File—Not a Pile—Stop Forgetting

By Prof. Henry Dickson



PROF. HENRY DICKSON, America's foremost authority on Memory Training and Principal of the Dickson Memory School, Hearst Bldg., Chicago.

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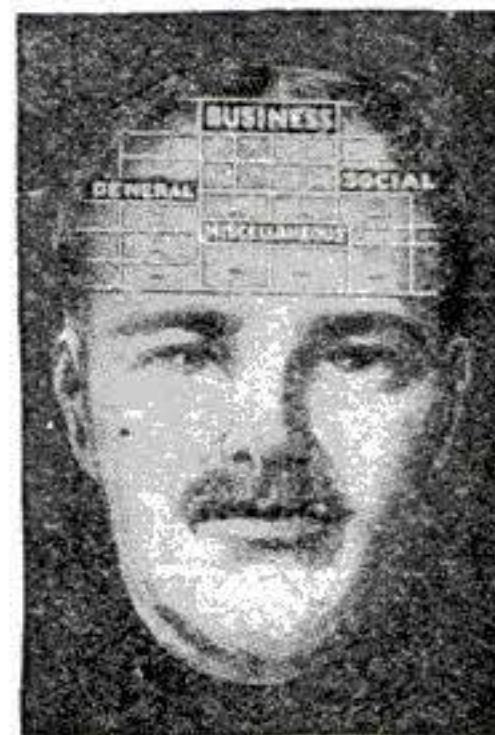
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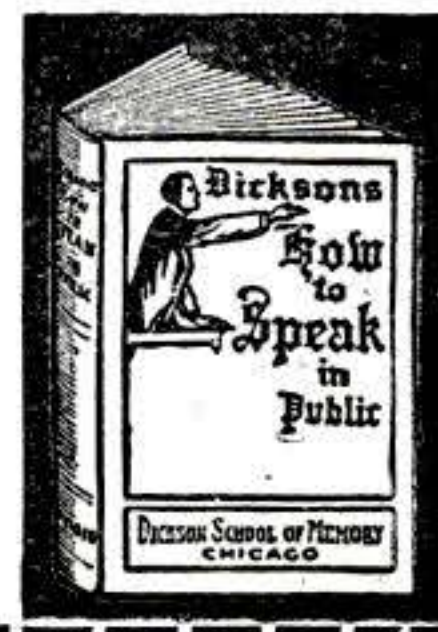
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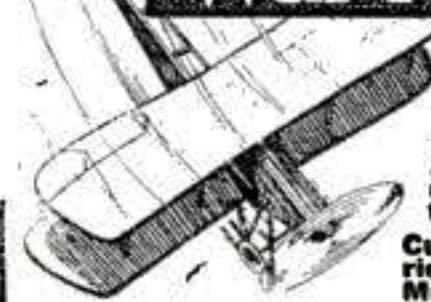
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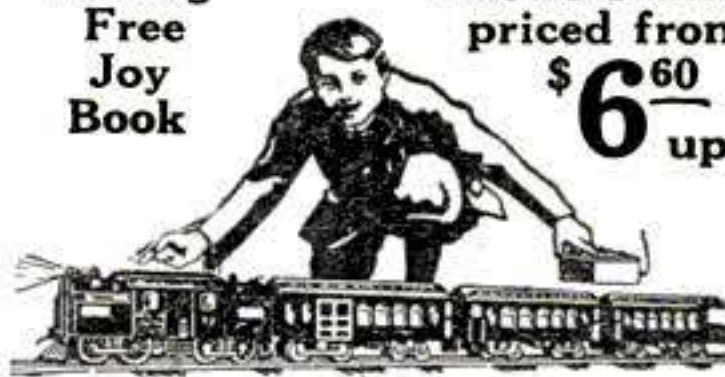
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from the tripod. If there is a bare space on the ground for this performance a little real fire may be kindled under the kettle and some marshmallows toasted, thus adding to the enjoyment. If it is best for the assembly to meet indoors, a fake fire can be produced with a few sticks of wood and

Two screws, A and B, are screwed part way into the base, being placed about 3½ in. apart. The hair spring, C, is then soldered to them at the proper height to bring it well across the magnets. You will notice that the spring curls to the right around A and to the left around B. The mag-

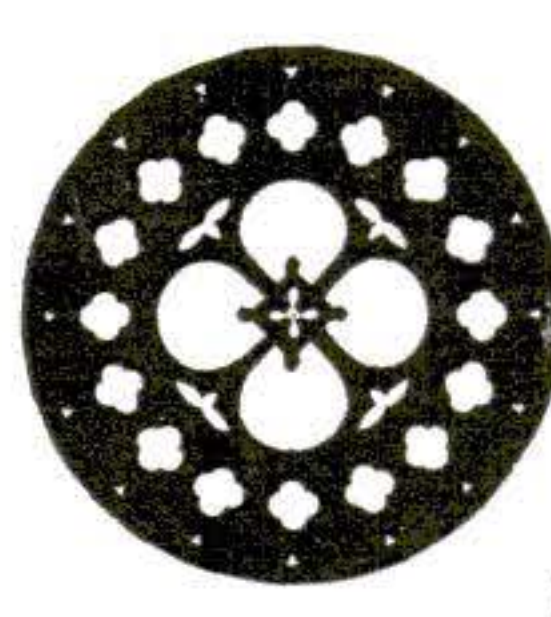
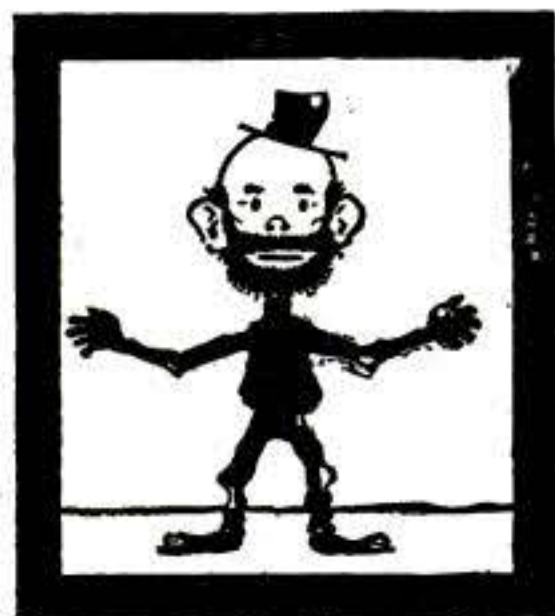


Fig. 5

Various designs for making window posters. Also a lantern of a round form that can be made of a hat box, the design for this being taken from a cathedral window

some red crepe tissue paper with a hidden electric bulb underneath. Use sufficient paper so that it will not have the same brilliancy throughout. Some parts should only have one thickness while other places should have several. When the witch has muttered and stamped and blown at the fire someone may turn on the light. The witch should be dressed in loose black gown with a tall peaked hat. She stirs the kettle and mutters and the others around the circle moan in chorus. In the bottom of the kettle are a few live coals, and if this can be used outdoors, every now and then the witch sifts in a little red or green light powder, and there is increased moaning. The powder must not be used in sufficient quantities to give a great amount of light, but just enough to give quite a little color. If used inside there must be good ventilation, otherwise the light powders must be omitted. The lights of the house should be subdued by covering with red or green crepe paper. Red or other colored light bulbs may be found useful.

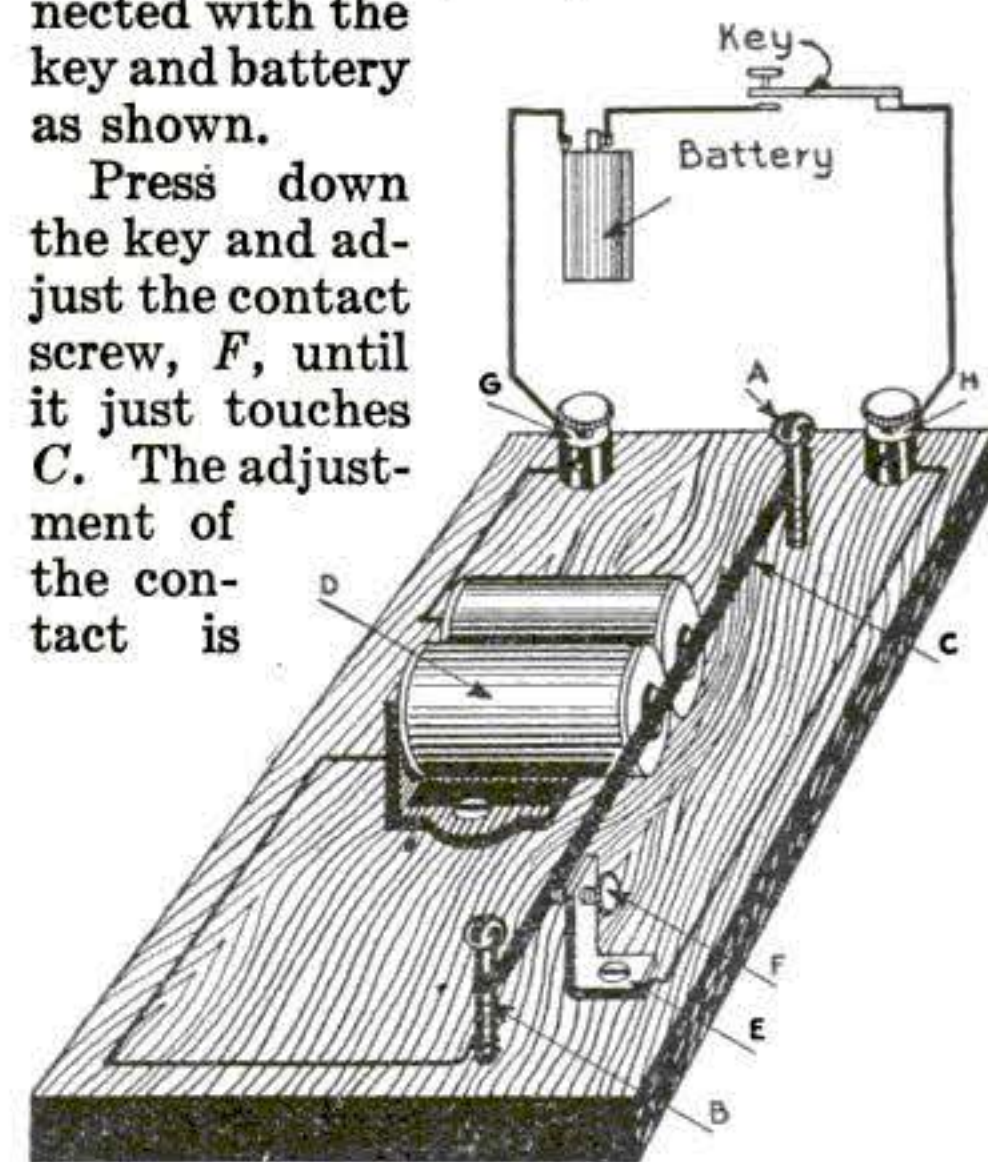
Code-Learning Instrument to Sound Tone Like Wireless

HERE is an instrument for learning wireless telegraphy that is superior to a buzzer. It can be easily made from old electric bell magnets, the hair spring of an old alarm clock a few screws and a piece of brass. The instrument will give a high singing note almost identical with that heard in the receivers of a wireless set.

nets, D, are next put in place half-way between A and B. The core points should be about 1/16 in. from the spring, C.

A small piece of strap brass, E, is bent and put in position. It should have a threaded hole for the contact screw, F, which is also put in place. The instrument works best if the point of contact made on C by F is about ½ or ¾ in. from B. The binding posts, G and H, are put on and connected with the key and battery as shown.

Press down the key and adjust the contact screw, F, until it just touches C. The adjustment of the contact is



Old electric bell magnets mounted on a base to make a buzzer

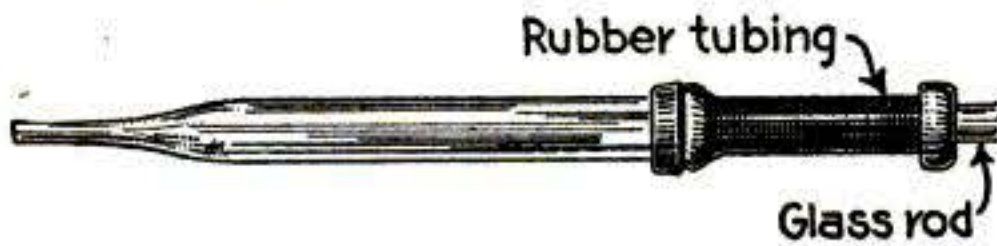
very delicate and as the results depend upon the contact and the tension of the spring, C, it must be carefully done. The spring should be of sufficient tension to keep it away from the magnet

points, but loose enough so that by pressing on it with the finger it can be made to touch.

The tone of the instrument may be raised or lowered by slightly turning the screw, A, in either direction, and adjusting the screw, F. Once the proper tone is secured, the adjustment should never be touched unless necessary.—ALBERT E. JONES.

A Substitute for a Bulb on a Medicine-Dropper

A MEDICINE-dropper can be repaired with a piece of scrap rubber tubing to take the place of the rubber bulb. The tube should be about 2 in. long and 3/16 in. in diameter.



A piece of small rubber tubing and a glass rod make the substitute bulb

A piece of glass rod 1 in. long and 3/16 in. in diameter is inserted in the upper end. The ends of the tube are turned back to give the appearance of a nipple and make the tube fit tight on the rod and nozzle.

If a nozzle is not at hand it can be easily made by drawing a piece of glass tubing to a capillary bore after being softened in a Bunsen flame. A piece about 2 5/8 in., measured from the the center of the capillary stem, is cut off.—LAWRENCE C. GREENHAUS.

A Novel Boy Scout Range Finder Made of Mailing Tubes

PROCURE two mailing tubes, one about 1 in. in diameter and 10 in. long, and another that will fit snugly over it and about 8 in. long. At the outer end of the large tube fix a piece of glass with parallel lines 1/8 in. apart. These lines may be scratched in the glass with a file. An eye-piece may be glued to the end of the smaller tube.

After carrying the work thus far the inner tube on its outside surface must be graduated. This is done by using a helper who stands at a distance of one or two thousand yards from the



Two mailing-tubes that will telescope are made into a range-finder

boy with the range finder. The latter holds the instrument to his eye and extends the parts until the boy at the distance appears of a height exactly the same as that between the parallel lines. A mark is then made on the smaller tube at the end of the other one. Continue the operation while the helper travels toward the finder and make marks at each 10 or 100 ft. as the space decreases. In this manner the finder may be used quite accurately in determining the distance at which a person stands from the observer.—H. A. TRESTER.



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With the help of a long stick, blocks are pushed under the raised building

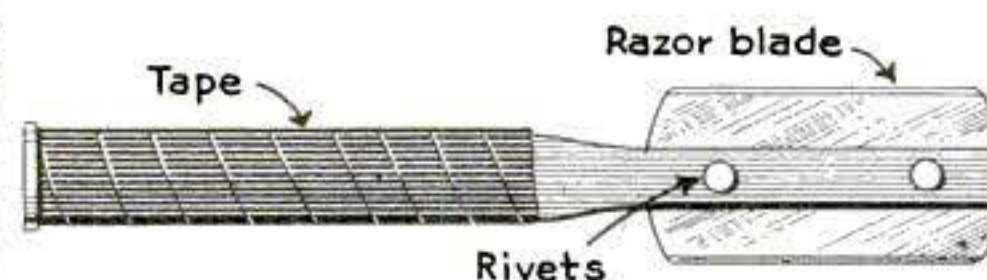
little ingenuity he raised the low corners as shown.

With a 10-ft. piece of timber he had a lever that could be fulcrumed on a rock and was equal to the lifting when his weight was put on the end of it. But that took him so far away that the building was in the distance and any moving up on the timber or off of it unbalanced the "power" end of the lever. Flat stones of ample size were already in the ground at the corners, and it was the intention to use bricks to form the piers. Arranging the bricks as wanted and using a stick to shove them, they were very quickly put in place.

The wedges that made the final close adjustment were pushed in the same way, while the corner was raised to give plenty of room.—D. A. HAMPSON.

Making a Handle for a Discarded Safety-Razor Blade

WHEN the edge on a safety razor becomes too dull for use in cutting the beard it is usually thrown away, even though it is still keen enough to rip cloth or canvas and do many other like jobs where a pocket knife will not cut. It only requires a handle to make further use of the blade,



Two strips of tin riveted together over a razor blade makes the handle

and this handle may be made from two pieces of tin, or one piece folded with holes drilled in the ends to match those in the blade. The handle is made by wrapping tire or electrician's tape around the extending end until it is sufficiently large to grasp in the hand.

Before placing the tape on the handle one or two rivets should be put in the tin so as to make it rigid.

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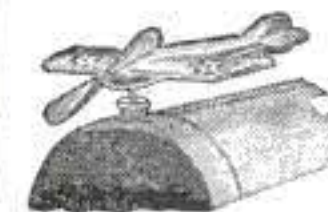
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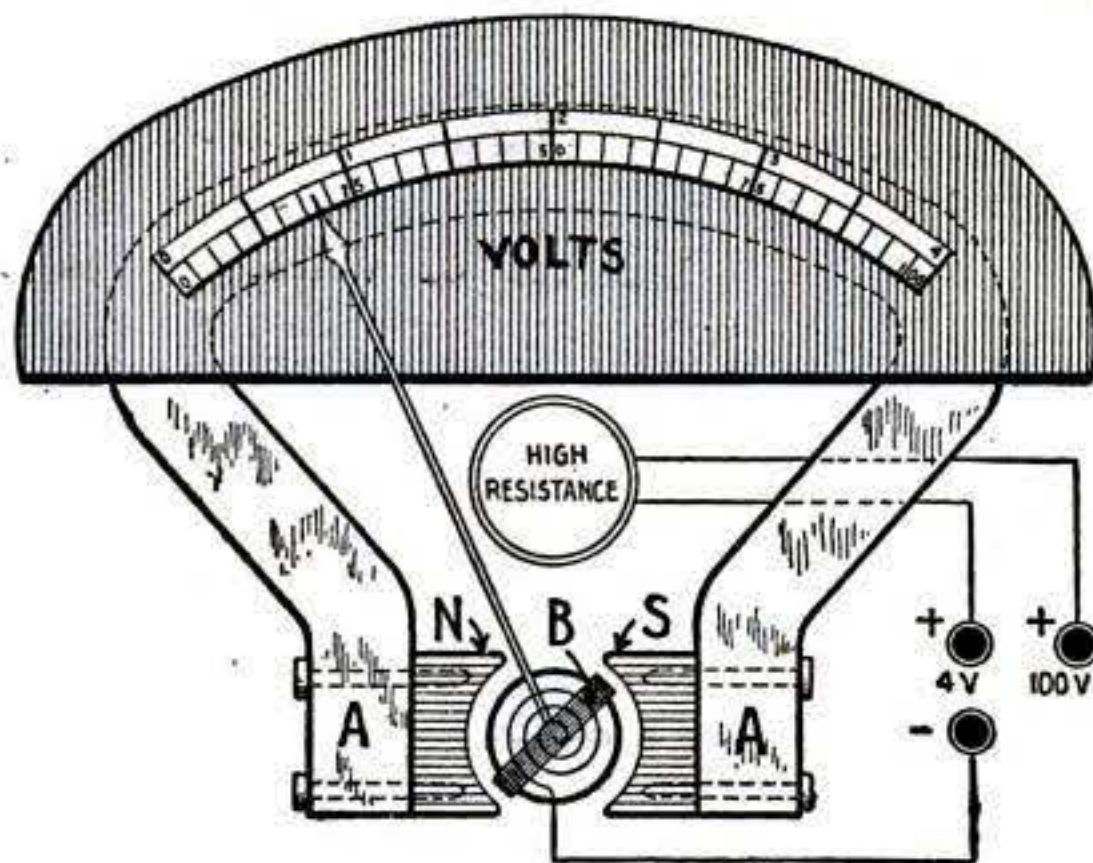
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How to Increase the Range of a Voltmeter

VOLTMETERS are made to measure pressure—or potential, as it is called by electricians—and if we have one of these instruments which was manufactured to measure from 1 to 6 volts pressure, we do not try to measure 50 to 100 volts with it, because a damaged instrument would

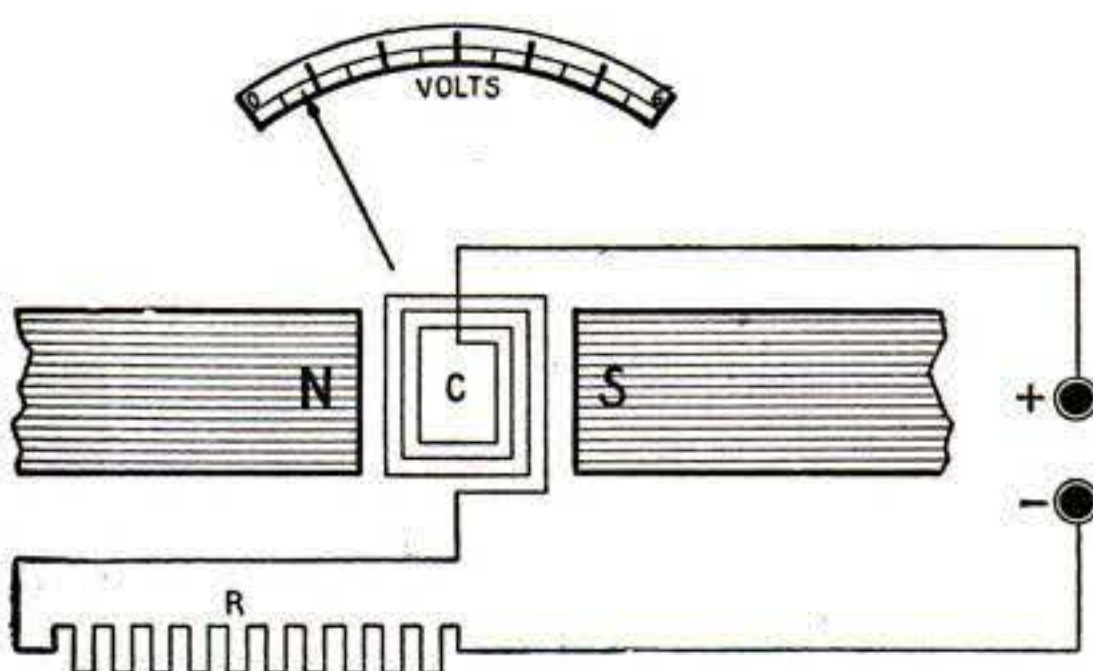


STANDARD VOLTMETER
FIG. 1

The permanent magnet of a voltmeter concentrates its strength at the lower ends

result. Or, if we have an instrument manufactured to measure a potential or pressure of from 0 to 500 volts we cannot with much accuracy measure currents ranging from 1 to 2 or 3 volts.

It is often desired to use an instrument ranging from 1 to 6 volts for measuring some source of electrical pressure which we estimate will be about 50 or 100 volts. To do this we must get another voltmeter or know some way of modifying the smaller instrument. It is possible with a low reading, standard voltmeter to measure currents of as high potential as 1000 volts, although 500 volts is the practical limit. For example, if a person has a voltmeter made to measure currents ranging from 1 to 6 volts, by connecting in series with it certain resistances of different values he can make the instrument read any set of values of current potential up to a



C = 200 OHMS. R = 2200 OHMS. CAPACITY = 6 VOLTS
FIG. 3.

Showing how a resistance coil is connected in the circuit with the movable coil

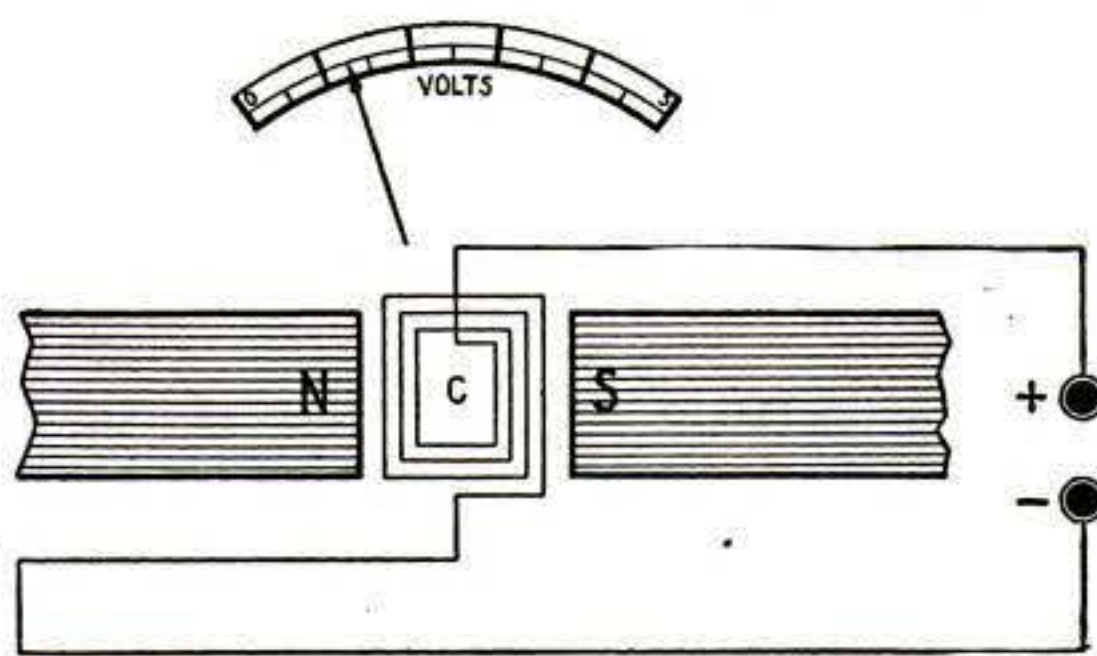
certain limit. The range depends on the value of the resistance in series with the meter and the limit depends on the quality and type of insulation used when constructing the resistance.

The explanation of this is somewhat

as follows: The permanent magnet of a standard voltmeter is made in such a shape as to concentrate its magnetic strength or its total numbers of lines of force at its points A, Fig. 1. At these two ends of the magnet are fastened pieces of soft iron, N & S, with a circular opening between them. In this opening, on very delicate bearings, swings a little coil, B, at right angles to which is fastened a pointer.

Now suppose a current should pass through this coil. This would develop a magnetic field. The lines of force of this field would flow through the coil, making the top side of the coil a north pole and the lower side a south pole. When this is the case the lines of magnetic force set up by the coil flow in the same direction as the pointer points.

The lines of force which are caused by the permanent magnet, flow from the north pole of the magnet directly across the opening in which is the coil. It will be seen that we now have two sets of lines of force. One of the fundamental laws in the science of electro-magnetism states that when two sets of lines of force come into contact they have a tendency to turn and coincide. In other words, both will flow in the

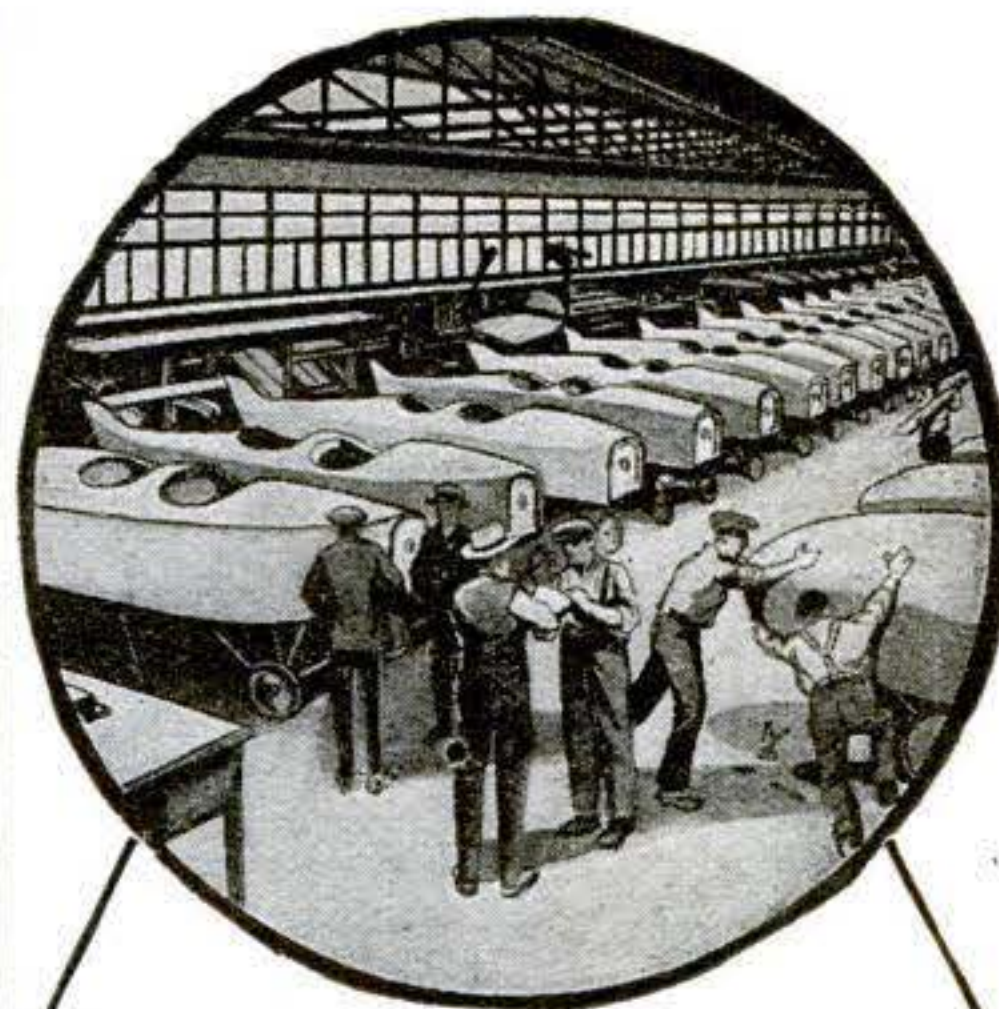


C = 200 OHMS. CAPACITY = .5 VOLT
FIG. 2

Diagram of the coil as it is connected to the binding posts of the instrument

same direction. As long as the coil and the magnets are in the same relative positions, the lines of force must flow criss-cross as they are generated; so they exert their force to turn either the coil or the magnets. As the magnets are firmly mounted, it is impossible for the lines of force to turn them; so they turn the coil, which in turn moves the pointer, by which we who are watching the instrument come to the conclusion that a current of electricity is passing through the instrument and are able to calculate its strength. If there were nothing to oppose the motion of the coil it would swing until the lines of force, which it generates entirely, coincided with the lines of force of the permanent magnet.

However, the motion generated by the magnetic fields is opposed by two very fine springs similar to the hair-spring in a watch or clock. It is also by means of these small springs that the current is carried to the moving coil.



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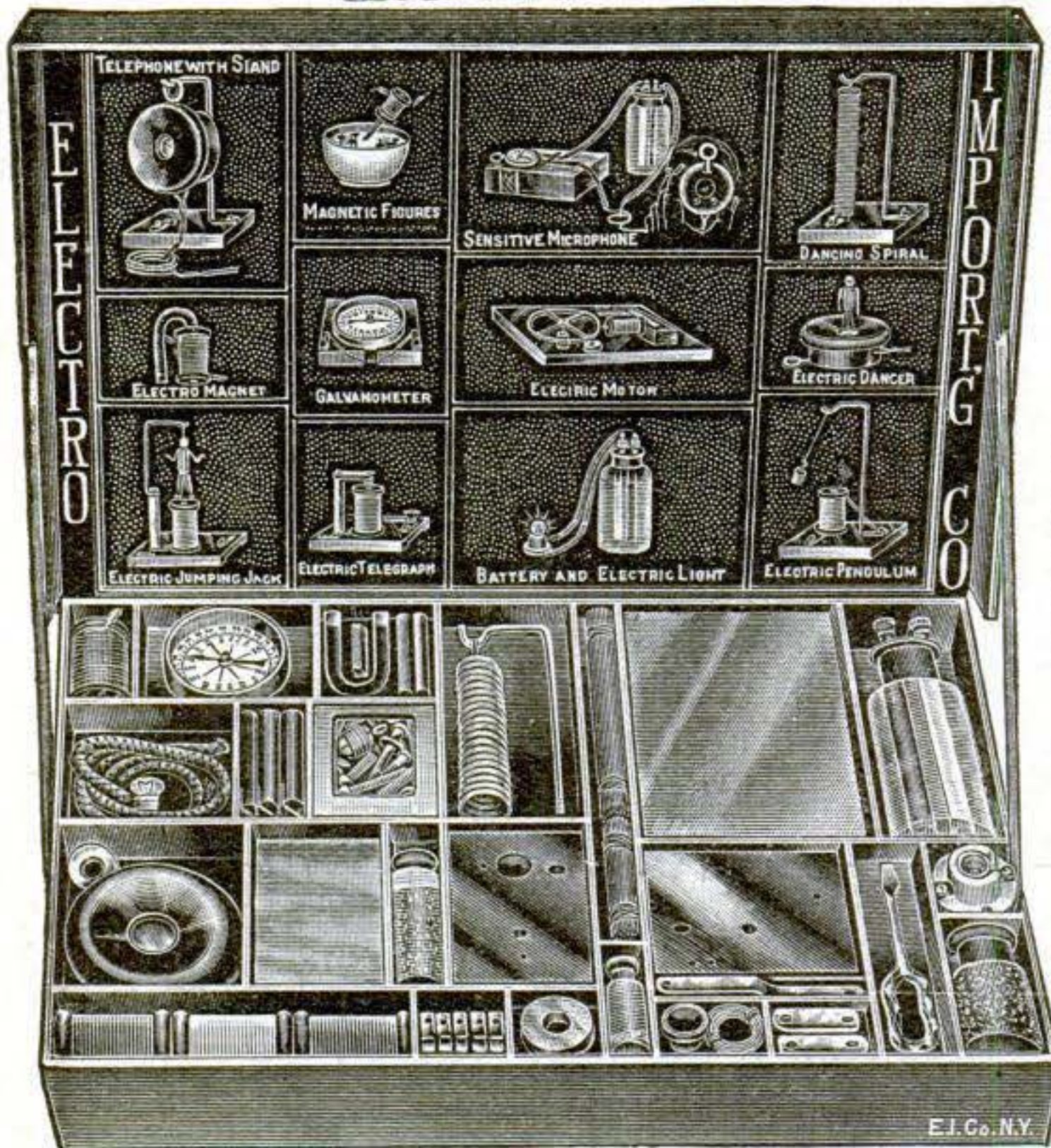
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TO BE PERFORMED WITH
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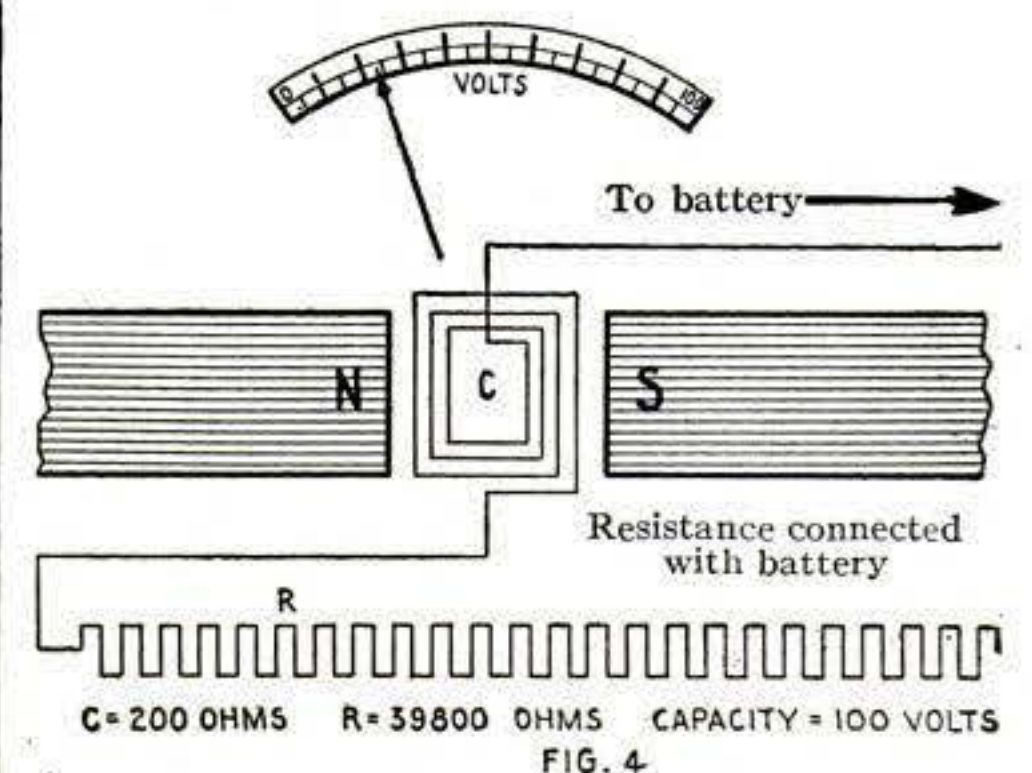
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When the force, caused by these two magnetic fields, has moved the coil until the torsion of the springs is equal to the magnetic force, then the coil will stop or come to rest at the point where these two opposite forces are equal.

The stronger the magnetic field set up by the coil, the greater will be the force which will cause the coil to move. The strength of this magnetic field will depend on the strength of the current which flows through the coil, or in other words, on the number of amperes, but not, as is commonly supposed, upon the number of volts. Voltage itself without amperage has no electro-magnetic effect at all. But as a higher voltage forces more amperage through the same resistance and as the higher amperage produces greater magnetic effect, it seems a natural conclusion that the increased magnetic effect is due to the increased voltage; but this is wrong.



There are a few voltmeters of the type shown in this diagram

Returning to the voltmeter, suppose that this meter with the coil connected directly with the binding posts of the instrument will measure currents from 0 to .5 volts. (Fig. 2.) Suppose that the resistance of the coil is 200 ohms. Then by Ohm's law (current = voltage ÷ resistance) we see it takes .0025 of an ampere of current to make the coil revolve through its total revolving limit. Since it takes only .5 of a volt to force .0025 amperes through the coil whose resistance is 200 ohms, then with nothing but this swinging coil in circuit we say the voltmeter has a range from 0 to .5 volts. Supposing that we connect a resistance coil wound out of some kind of resistance wire, whose resistance measures 2200 ohms, in the circuit with the movable coil (Fig. 3), then apply enough voltage at the terminals of the instrument to force, as before, .0025 amperes of current through the coil, so that the pointer will show its extreme deflection. Using Ohm's law again (current = voltage ÷ resistance) we have (.0025 = volts ÷ 2400). The total resistance equals the outside resistance, 2200 ohms, plus the resistance of the coil, 200 ohms, or 2400 ohms. Working out this equation we have, volts = .0025 × 2400 or volts = 6. So we see that to measure a current whose pressure is 6 volts we must have sufficient resistance in the circuit so

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that 6 volts can push only .0025 amperes through the movable coil. Suppose that we wish to make the voltmeter measure 100 volts. To do this there would have to be just enough resistance in series with the coil to cause 100 volts to push .0025 amperes, and no more, through the swinging coil. To do this figuring from the ohm's law, we have $.0025 = 100 \div \text{resistance}$. From this we get the resistance as 40,000 ohms. Since 200 ohms of this is already in the coil the external resistance, or the resistance which must be connected in series with the coil, is 40,000 less 200 or 39,800 ohms (Fig. 4).

Current Required

This is the type and mode of construction of a few of the standard voltmeters, such as the Weston. Because these instruments require such a small amount of current they are very efficient. For example: when measuring 100 volts, a current of .0025 amperes is required, which represents a consumption of .25 watts or $3/10,000$ of a horsepower of electrical energy. This is $1/100$ of the amount of current consumed by a 25-watt tungsten lamp.

But the voltmeter does not have to be of this type to change its range. The range of any type of a voltmeter may be changed in the same manner—even the small watch type. All these instruments require a certain number of amperes to operate them, and if the resistance of the meter is increased so that a higher voltage can push only a like amount of current through the acting coil, whether that coil be movable or stationary, we may thus increase the range of the meter.

The increase in range, the resistance of the meter, the extra resistance added, the highest reading ordinarily on the meter, the highest reading desired—all may be represented by the formula:

$$R' = R \left(\frac{v' - v}{v} \right)$$

Where R' = the resistance in series with the meter.

R = the resistance of the meter.

v' = the highest reading desired.

v = the present highest reading.

By substituting the values for R , v' and v in the formula the values for the extra external resistance R' may be found, for any desired increase in the reading of any ordinary voltmeter.

These extra resistances may be wound from German silver resistance wire. This kind of wire may be obtained with an extra quality of enamel and cotton insulation at any electrical supply house.

These resistances should be wound non-inductively; or in other words, so they will produce no electromagnetic effect. To do this the piece of wire should be doubled in the middle. Then starting with the doubled end, wind both wires in the same direction. If the wire is very long this is rather inconvenient, so two ends of two separate wires may be soldered together, insulated at the joint, then both wires



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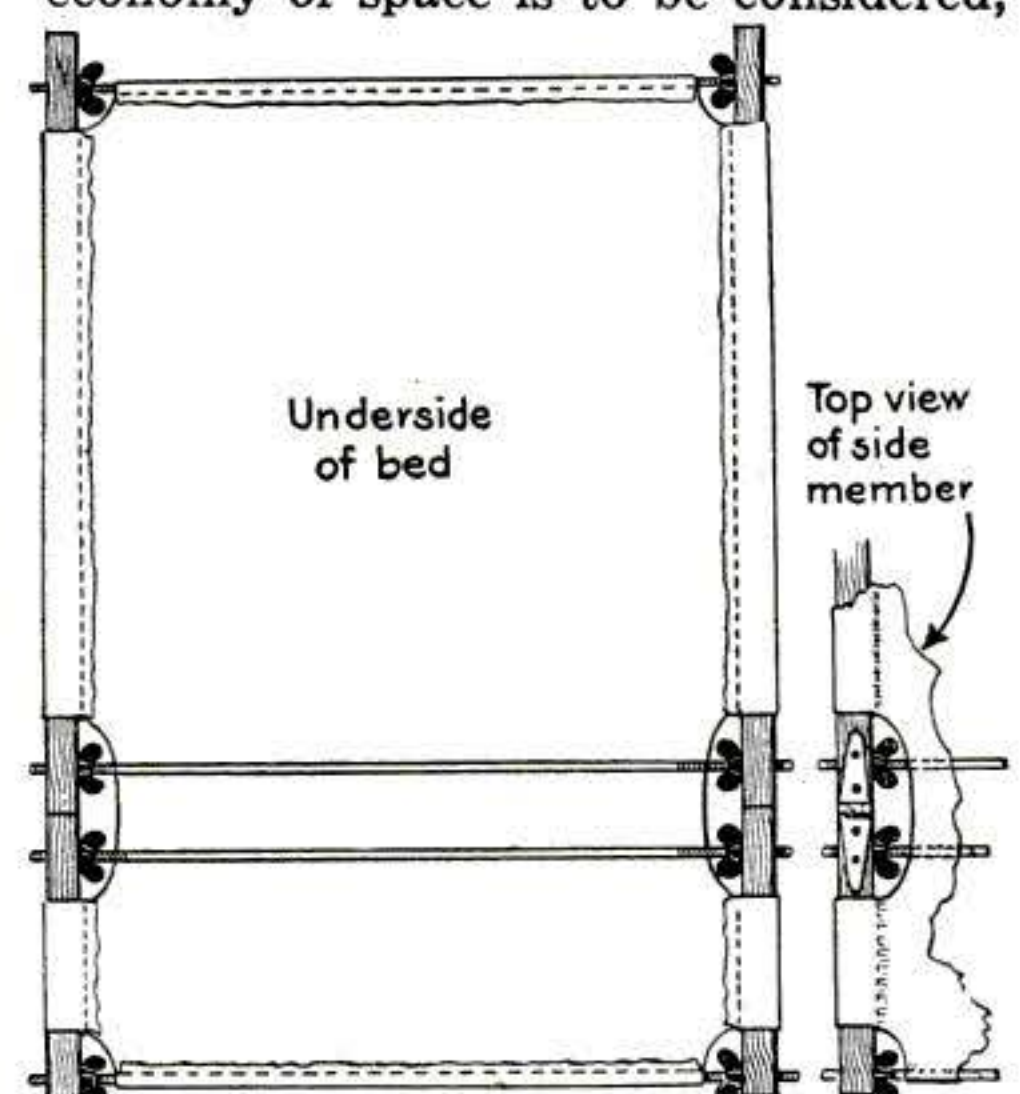
wound in the same direction around the spool. Another way which is still more convenient but less effective is to wind a certain number of turns of one wire in one direction, then the same number in the other direction, and so on until the required amount is on the spool. The wire used in making these resistances should be of at least as high carrying capacity as the wire in the active coil. When this is the case the pointer of the meter will show when the wire in the active coil is carrying its total capacity. Since the resistance in series with the coil carries exactly the same amount of current as the coil carries, if its capacity is the same as the wire in the active coil there will be no danger from heating.

Suppose we have a five-volt instrument to which we have added enough outside resistance to make it a 50-volt instrument. If we do not want to put on an extra calibration, or scale, we may read the voltage from the old one by multiplying the reading on the scale of 50/5 or 10. Or if we have made a 6-volt instrument into a 100-volt instrument we would multiply the scale readings by 100/6 or 16-2/3, and so on for any value of voltage.

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A folding frame covered with heavy canvas to make a camp-bed

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Make a little sketch of your invention on a sheet of paper. It doesn't matter how poorly you draw. I will give your idea my personal attention and report to you within two days of its receipt. I have rendered swift, efficient and trustworthy service to thousands of inventors and the same service is yours to command. Don't postpone. Other men may have the same idea. It is the man who secures the patent first who secures the fortune.

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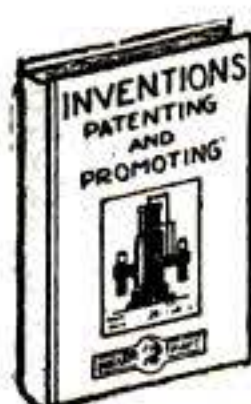
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date 1/2-in. rods easily. The upper hole was 3 in. from the top, the lower 2 in. from the bottom. Putting one of the poles across the top of the seats to my car, I marked a point just forward of the top of the front seat. At a point 4 in. farther down I made a second mark. At each point I made a 5/8-in. hole, and half way between them cut the pole squarely in two, fastening the sections together with a heavy strap hinge on the upper side. This gave a solid side member resting on the tops of the seats, with the section forward of the front seat so that it could be folded back if desired; the pressure of the inside ends of the two sections held in place by the strap hinge made them rigid when extended.

Taking 1/2-in. rods just long enough to fit inside the car with the side curtains down, I threaded them for 4 in. on either end, fitting each end with a thumbscrew.

Putting It Together

We were then ready for the bed proper. Instead of tacking heavy canvas to the side members we made pockets of sufficient size to admit the poles, as shown by the dotted lines in the accompanying illustration. A smaller pocket was made across the top and the bottom, through which to run the end rods and give strength lengthwise. These pockets should be large enough to admit the thumb-screws, if desired. At the break in the poles we cut the canvas away to permit folding the bed back, being careful to hem the canvas along the edges to prevent fraying. The canvas was also cut back at either end to operate the thumb-screws easily.

The canvas was slipped over the side members, and the two end rods run through the pockets left for that purpose, the thumb-screws on the inside of the poles acting as stretchers. The other rods were run through the holes on either side of the break in the poles, in this case being carried under the canvas. The thumb-screws were tightened uniformly until the desired tension was secured. Then we had a bed that was strong and comfortable, and which, when not in use could be stowed away in small space.

If the car has sufficient wheelbase so that a full length bed can be installed between the front and back seats, there will be no necessity for cutting the side members and using strap hinges, as indicated. We found this advisable with a car of medium wheelbase because by folding the lower section back the front compartment of the car could be utilized for dressing purposes. Then, too, there were some rainy mornings when we did not care to go to the trouble of taking the bed apart, so we turned it back. To prevent the bed from slipping forward it is a good plan to put light brackets on the upper ends of the side members so that the right angle section will slip down between the back curtain and the back seat.—LEN G. SHAW.

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How to Hold a Dog or Cat for an Operation

WHEN there is no veterinary at hand, a maimed dog or cat can be operated on, or its wounds dressed, with comparatively little danger of being bitten or clawed, if one proceeds in the following manner: If possible, induce the animal, for the convenience of the operator, to lie down on a table upon which a thin blanket has been placed to be used as a bed.

Have at hand several large screw-eyes (fence staples will do) and a few feet of very tough cord. Turn the screw-eyes in the table at the points along both sides of the animal's body;



By means of strings run through screw-eyes turned into the table top the dog is held firmly

then, beginning at the head, proceed to bind the patient securely with the cord, drawing it tightly back and forth through the screw-eyes, taking care to secure the neck well and the rear legs above the knee-joints.

An assistant can add to the safety of the work by gently holding a blanket over the animal's head. A knife should be used for cutting the cord to release the animal.—G. PINCKNEY.

An Elastic Dammar Varnish for Coating Photographs

TRANSPARENT and clear pieces of dammar are crushed into small grains, and about 40 grams (1.4 oz.) introduced into a flask. Over this 6 oz. of acetone is poured and is exposed at a moderate temperature for a period of about two weeks, being shaken frequently from time to time. The saturated solution of dammar in acetone is poured off, and for every four parts of varnish three parts of rather dense collodion is added. Then the two solutions are mixed very thoroughly by agitation.

The resulting liquid is then permitted to settle, and placed in well closed vials. The varnish must be applied in vertical lines by means of a soft brush. It keeps its gloss under all atmospheric conditions, and retains its elasticity—the latter quality making it especially adaptable to topographic crayon drawings and maps, as well as photographs.

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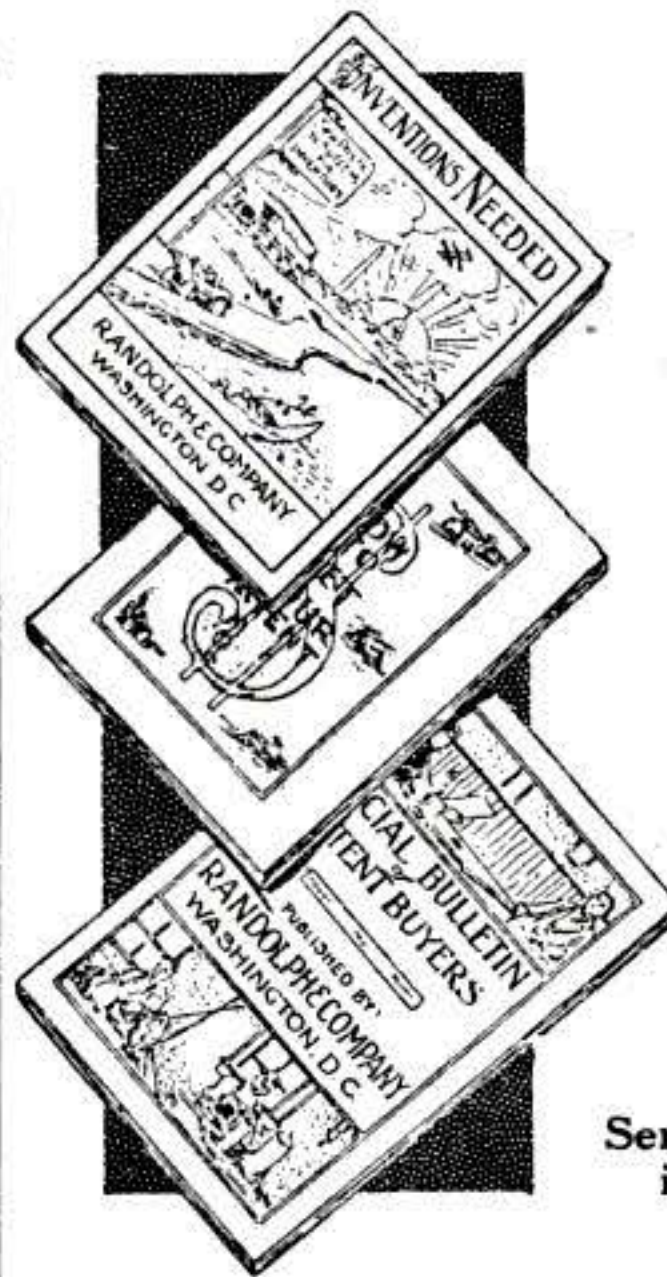
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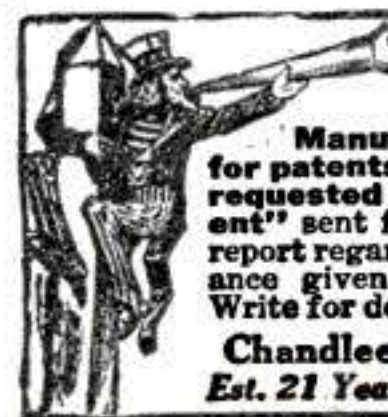
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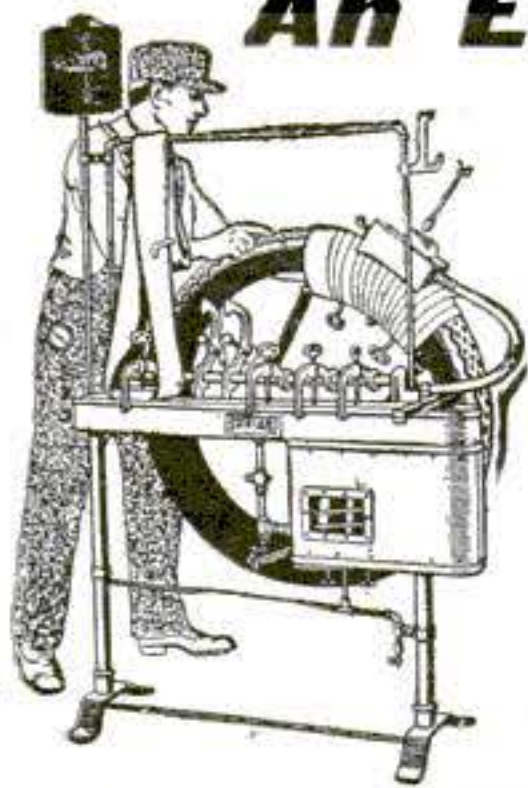
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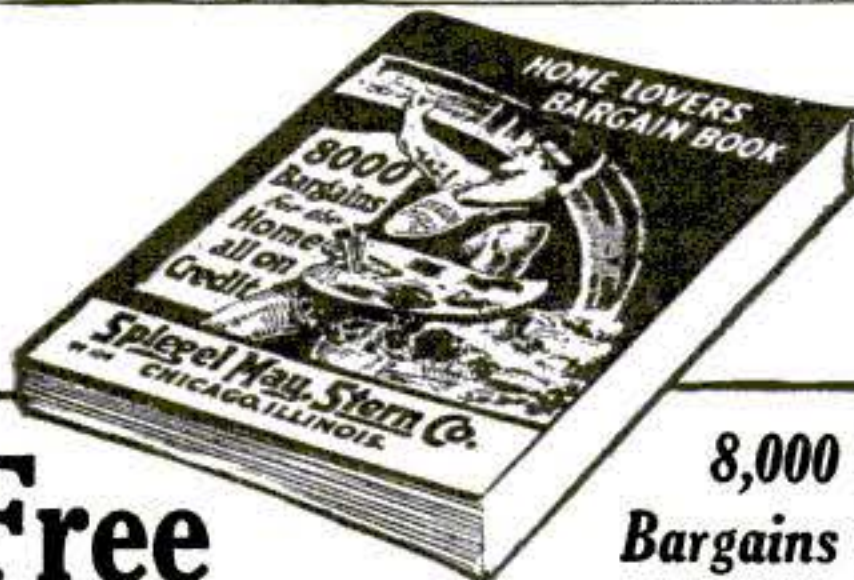
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Emptying Carboys by a Very Simple Method

FROM time to time various methods of withdrawing liquids from carboys by means of tubes and air pressure have been published, but most of these operate by suction. The objection to this is that if the suction is produced by a person applying his lips to one of the tubes and sucking in the air, the operation may result in serious injury to his lungs. Concentrated nitric acid, for instance, gives



The pressure produced by blowing through tube into the upper portion of the bottle forces out the liquid

off very harmful fumes. So do other acids; also ammonia. Moreover, the fumes are hard to expel completely from the lungs after once taken in.

The method shown in the illustration has none of these defects, and in addition is simpler than most other plans. It is in universal use in the chemical laboratories of a large middle-Western university. The withdrawal pipe had two bends in it as shown, and also runs almost to the bottom of the carboy. The flowing tube has but one bend, merely projects through the cork, and has the other end terminating in the rubber tube indicated.

Each student desiring some of the acid or other liquid in a given carboy, brings his bottle and also a short piece of glass pipe. The bottle he places under the open end of the withdrawal tube, and the pipe he inserts in the rubber tube to use as his own individual mouthpiece. Upon blowing into the tube (not sucking), the liquid is forced out, due to the air pressure set up within the carboy.

The student may blow two or three lungfuls into the carboy, remove his glass tube, and pinch the rubber pipe together with his fingers, imprisoning the air just blown in. This causes the liquid to keep on running out until the pressure falls completely off—which, if the student keeps the rubber tube tightly closed, may not occur until the carboy is half emptied. Then two or three more lungfuls blown in will complete the emptying operation.

Should the student want only a small bottle of the liquid instead of half a carboy, he need blow in but one



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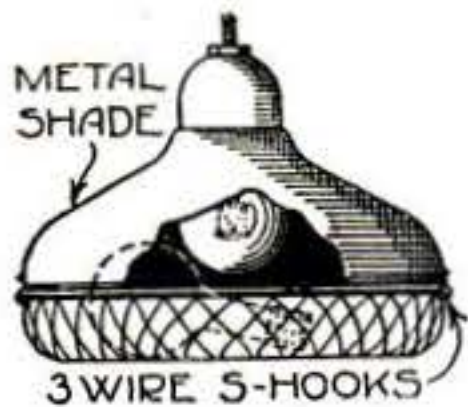


breath, and even let part of that out (by releasing his hold on the rubber tube) should the one breath prove more than sufficient to fill up his bottle with the liquid.

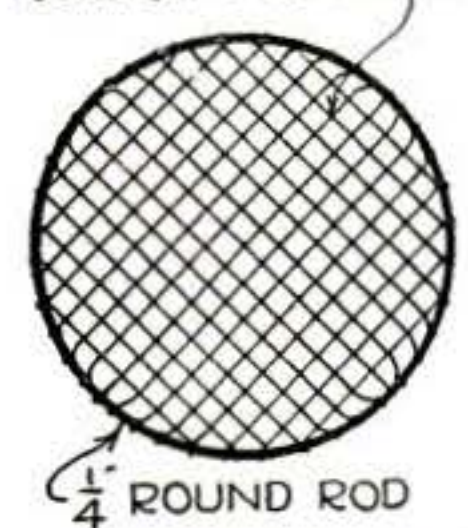
Thus the apparatus is easily operated, is simple, inexpensive, and conserves the liquid contained in the carboy—for no more liquid need be removed at one time than is necessary for the operation in hand. This is a decided advantage over another carboy-emptying method sometimes used—that of tipping the big bottle over on its side and letting the liquid gurgle out into a pitcher, for the liquid is apt to be spilled in the operation. The clumsiness and wastefulness of this method make it obsolete as compared with the plan here illustrated—particularly when the contents of carboys have to be drawn on often, as in a student laboratory.

A Lamp Guard to Keep Large Electric Bulbs from Falling

LARGE bulbs placed in sockets quite out of reach in a certain factory caused some trouble and expense, for occasionally one would work loose through the vibration of the electric cranes passing to and fro and would drop to the floor. To prevent them falling when they were loose, a guard was placed over the shade, as shown in the illustration. The guard which consisted of ordinary mesh wire used by poultrymen, was shaped to fit over the opening in the shade.—GEORGE L. SHEPHERD.



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Go to the jeweler's and get five or ten cents' worth of jeweler's rouge, either in powdered or stick form. Take a piece of soft chamois about 4 in. square, and rub some of the rouge on one side of it. After your silver is cleaned and dried, rub it over with the chamois, and finish off with a piece of clean dry flannel, and you will get a most beautiful polish.

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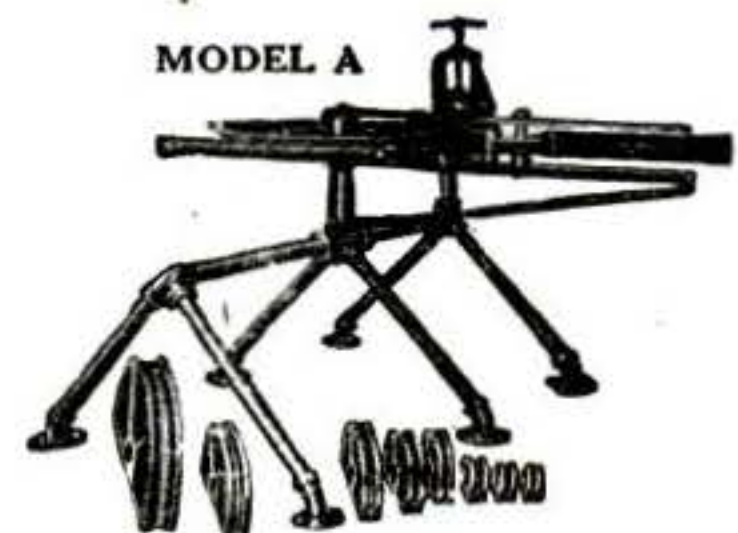
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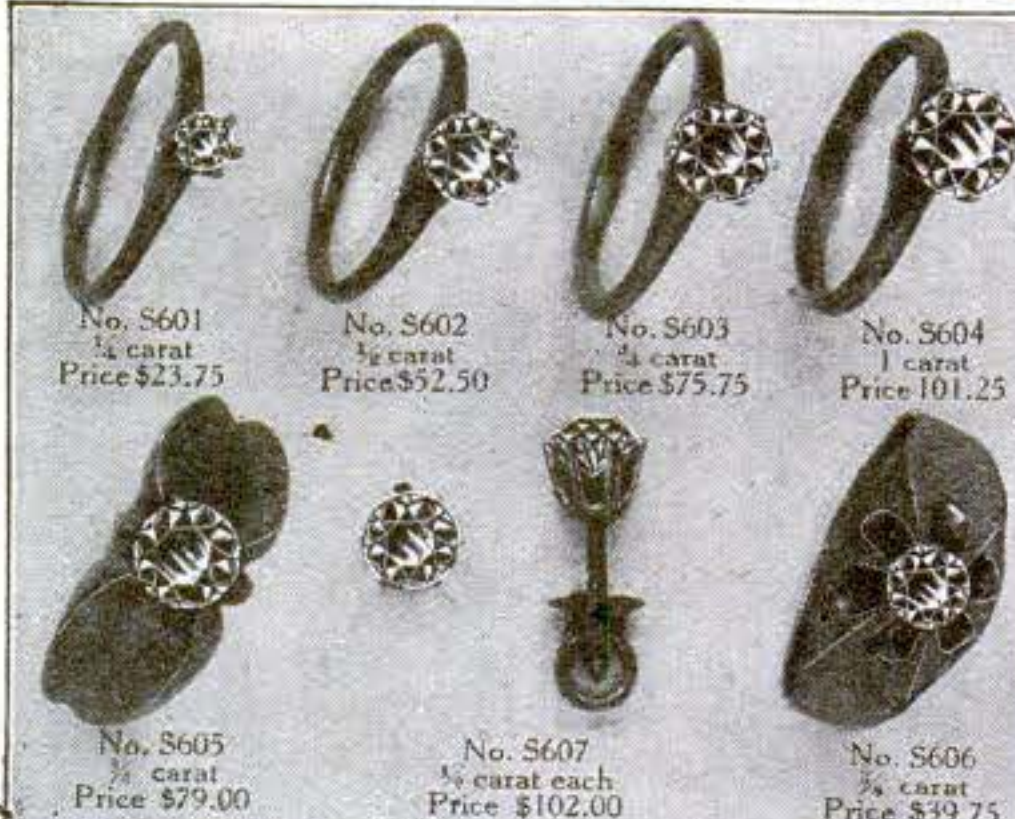
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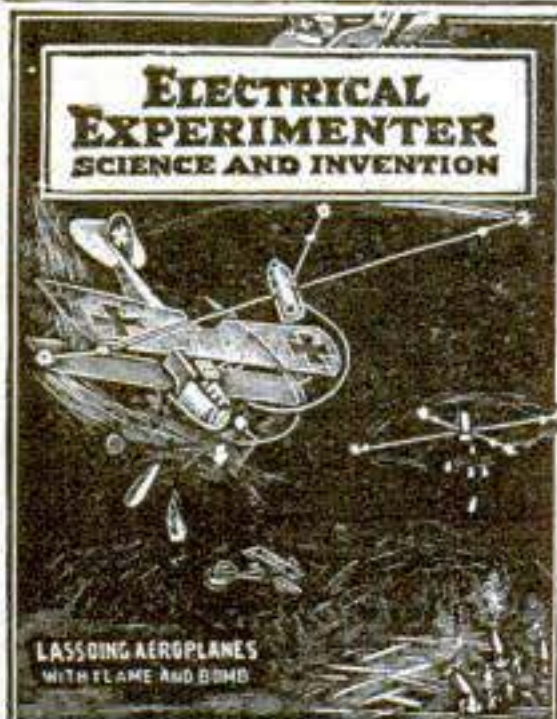
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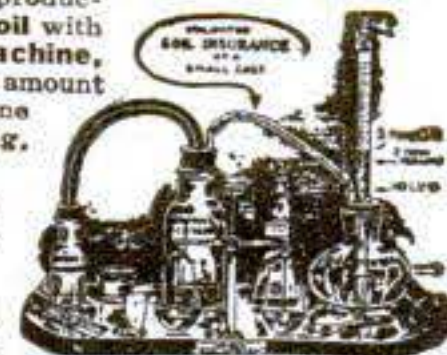
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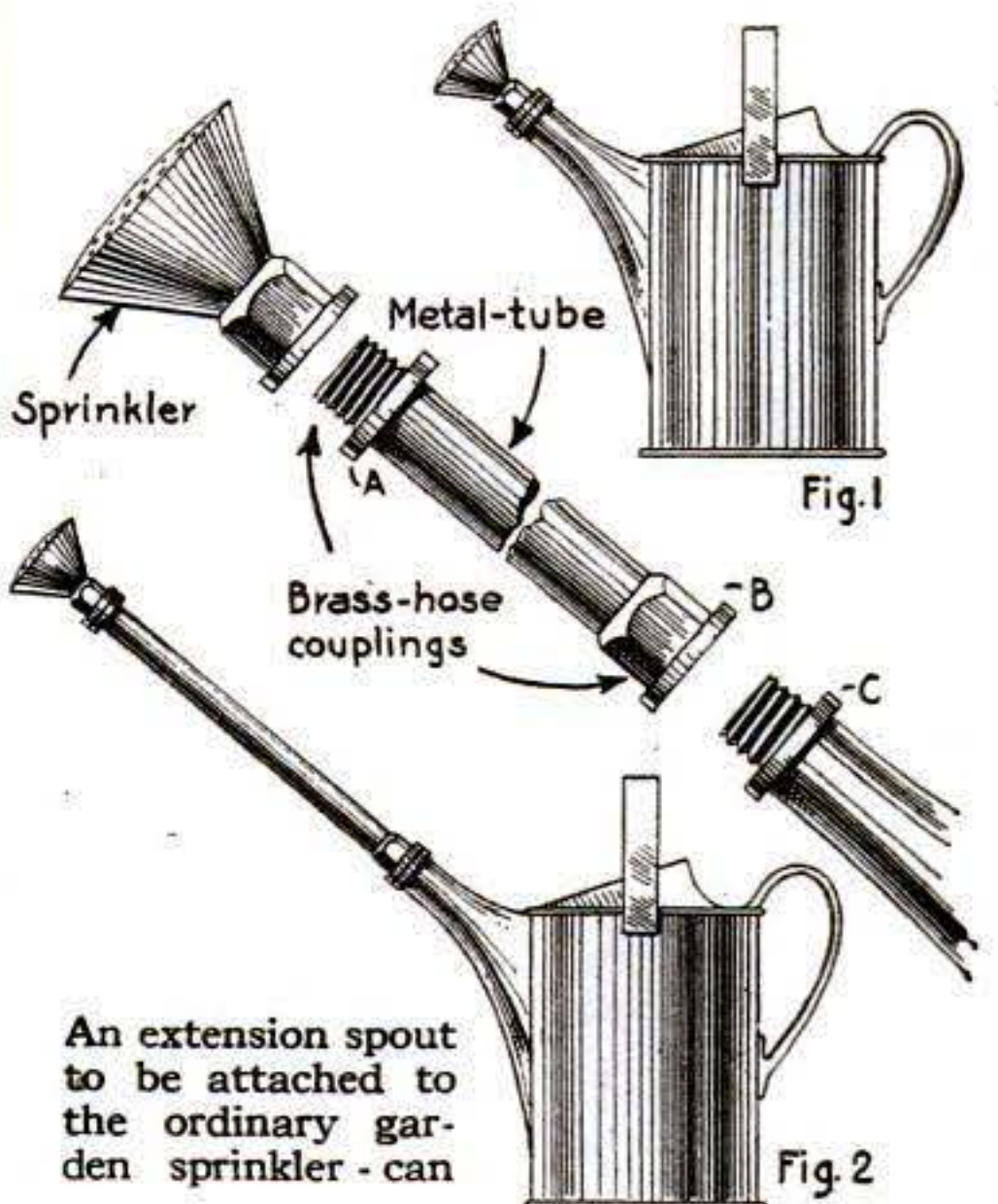


The flat side on handle meets the thumb

The illustrations shows how one side of the wooden pear-shaped handle can be filed off so as to present a small flattened surface to the thumb when picked up for use. It takes but a few seconds to do, and enables the stamp to be more conveniently used and handled.

An Adjustable Spout for the Sprinkling-Pot

A CONVENIENT adjustable watering-pot spout can be made out of a section of brass or tin tubing and two sets of hose couplings; old couplings will do. The construction is



An extension spout to be attached to the ordinary garden sprinkler - can

clearly shown in the illustration. The sections of the couplings have to be soldered in place. Leather washers should be put in at A and B. With this arrangement the "rose," or sprinkler end, can be attached to the short section, C, if desired.

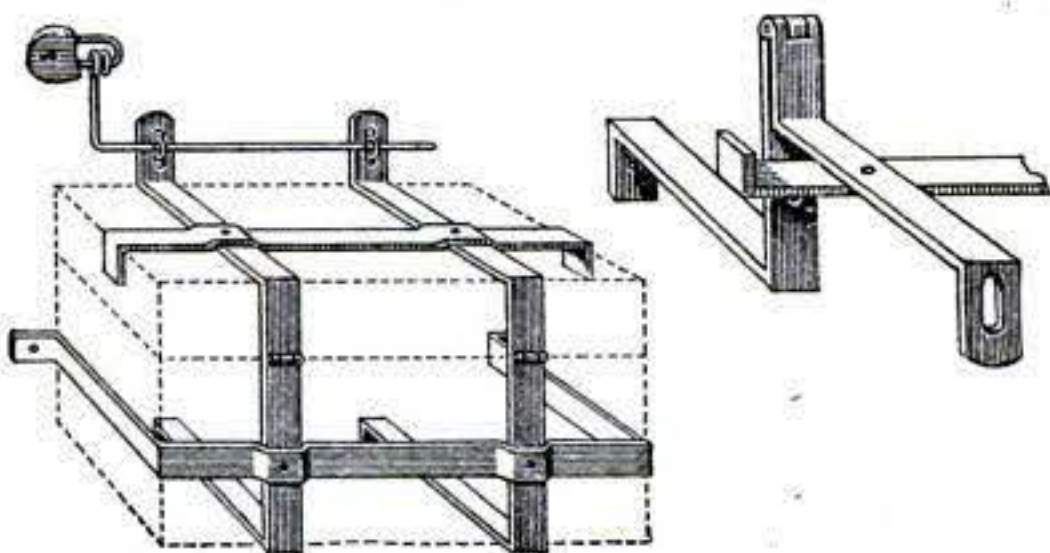
Figuring the Weight of Ice When Its Volume Is Known

A VERY close estimate of the weight of any block of ice may be ascertained by applying the following method: The volume of the ice in cubic inches is obtained by multiplying together the three dimensions. Dividing the product by thirty gives the weight of the ice in pounds. For instance, if the block is 10 by 10 by 12 in., its volume is 1,200 cubic inches; dividing this product by thirty gives 40 lb. as the correct weight of the ice.

A Locking Cage Shield for a Spark-Coil Box

THE owner of a small car, parking it for a short time, found on his return that the spark-coils had been removed from the box and two damaged ones substituted. After having purchased a new set he decided to prevent a recurrence of the theft, and made a metal cage like that in the illustration to enable him to lock the box with a padlock.

Small mild steel strap metal, 3/16 in. thick and 1 in. wide, was used in the

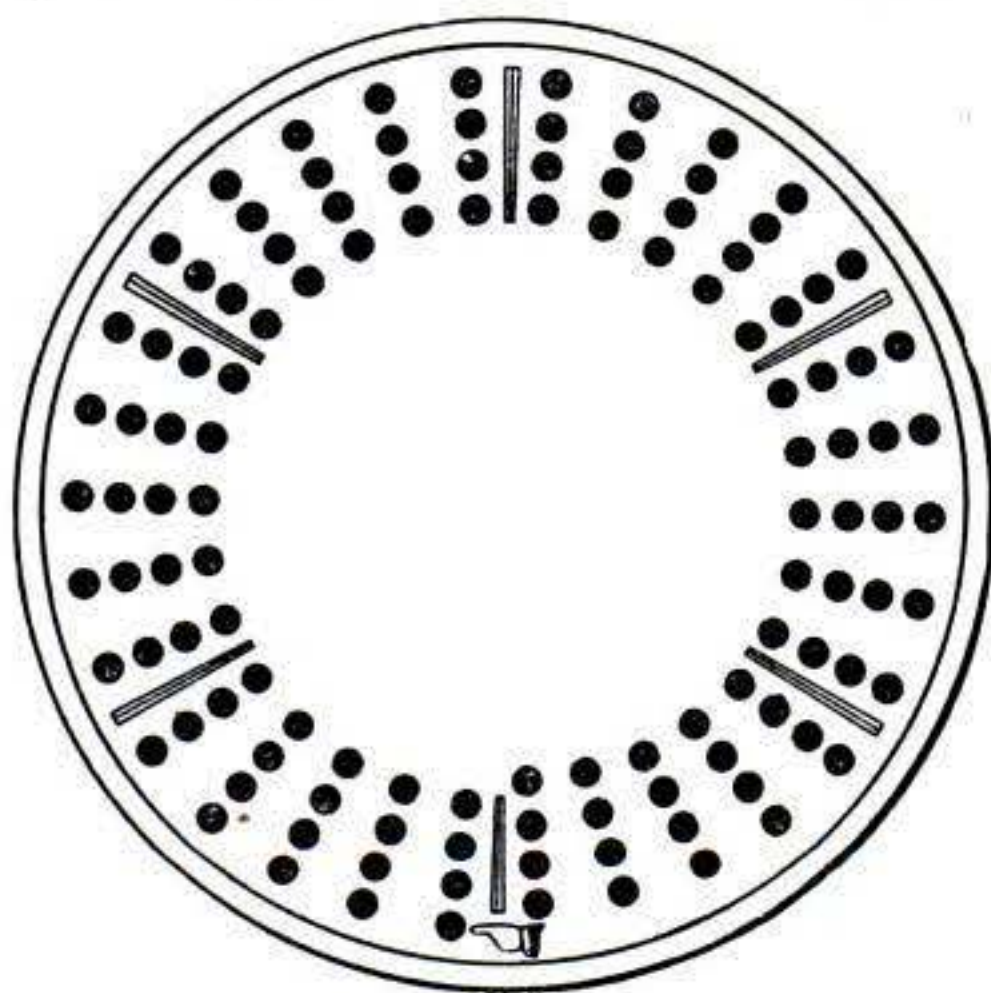


Straps of iron built into box-shape around the spark-coil locks it in place

cage construction. The cage incloses the box. The main pieces passing over the box vertically are hinged at the joint of the box cover, their forward ends being slotted to receive staples. The whole cage is fastened to the dash over the spark-coil box. Two screw-eyes, a long rod run through the staples, and a padlock complete the locking device.—G. A. HAWKINS.

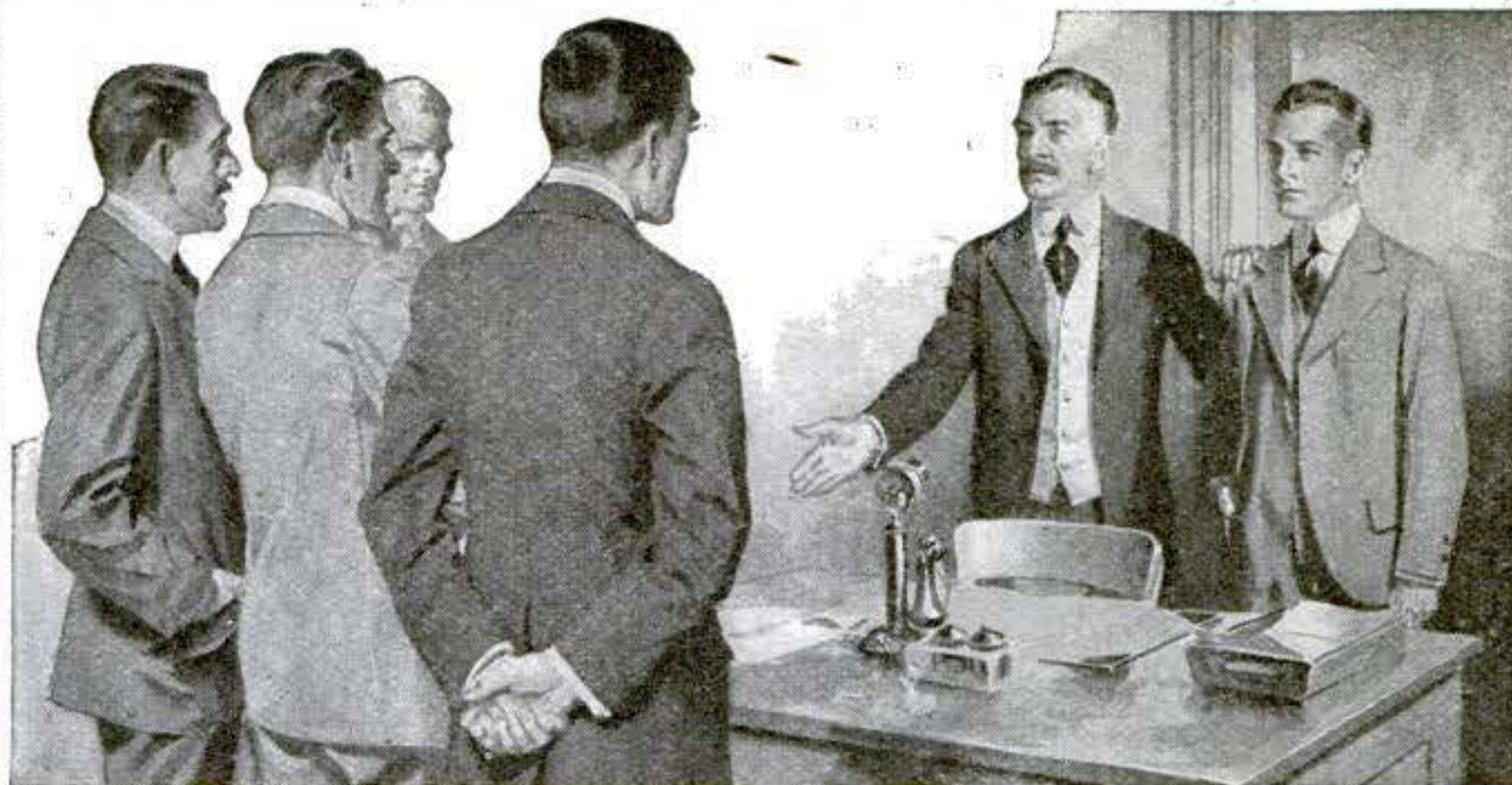
A Counting Disk Board for Cribbage Players

THIS, of course, is simply a new idea for the cribbage board. The advantage gained by the spiral track is that less space is required; a full game may be scored in one continuous



In a continuous run a full game may be scored with less liability to a mistake

run, whereas, with the ordinary square board, two rounds are required. The plan shown is only one-half the box. The other half is made to contain the playing cards and the pegs. Both halves fit together with a lap joint and both are perforated as shown. This contrivance gives each player a separate scoring track and makes mistakes and confusion less likely to happen.—HUNTINGTON BAKER.



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Electrical Devices and How They Work

X—Principles of alternating-current motors

By Peter J. M. Clute, B. E.

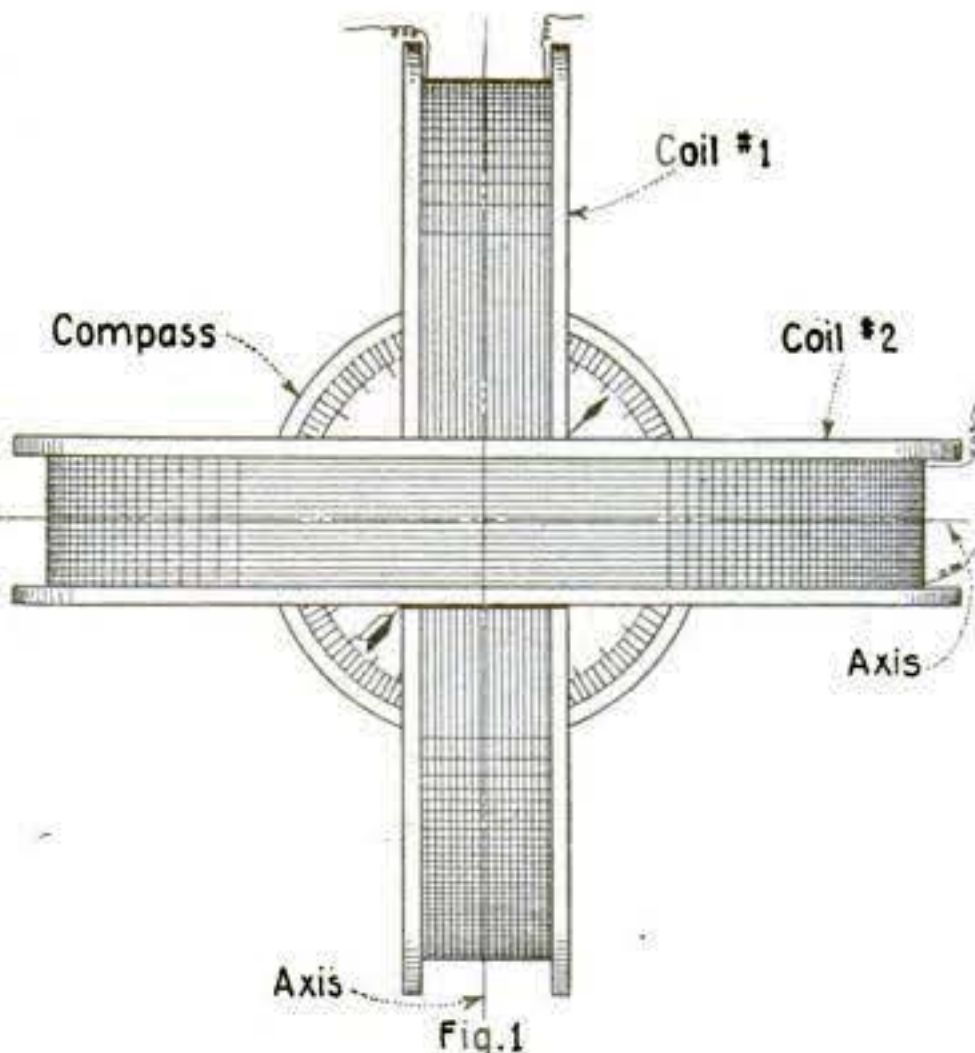
MANY of the types of small D.C. motors can be run on alternating-current circuits. This is readily apparent when it is recalled that changing the direction of flow of current in a D.C. motor, both armature and field, does not reverse its direction of rotation. Thus, when current

magnetic field is produced by the interactions of polyphase currents. Two-phase induction motors are sometimes used, although the most common form is the three-phase motor.

In the study of the induction motor it is of first importance to understand how a magnetic field may rotate while the coils producing the field stand still. The simple experiment here described explains quite clearly this important phenomenon.

A heavy ball is suspended by a cord about 8 ft. long and set swinging to and fro with an amplitude of at least 1 ft. At the instant when the ball reaches either end of its path of oscillation, give it a sharp, quick blow in a direction at right angles to its original path. Since the vibration of a pendulum is simple harmonic motion, this second blow will cause a simple harmonic motion differing in phase by a quarter of a period with the original impulse. If the second blow is of sufficient force to cause an amplitude of the same value as the existing one, the two simple harmonic motions, acting at right angles to each other, will cause the ball to rotate with a uniform circular motion.

The application of this principle to the rotating magnetic field is readily apparent. Two similar coils, through which two-phase currents are passed, are placed with axes at right angles to

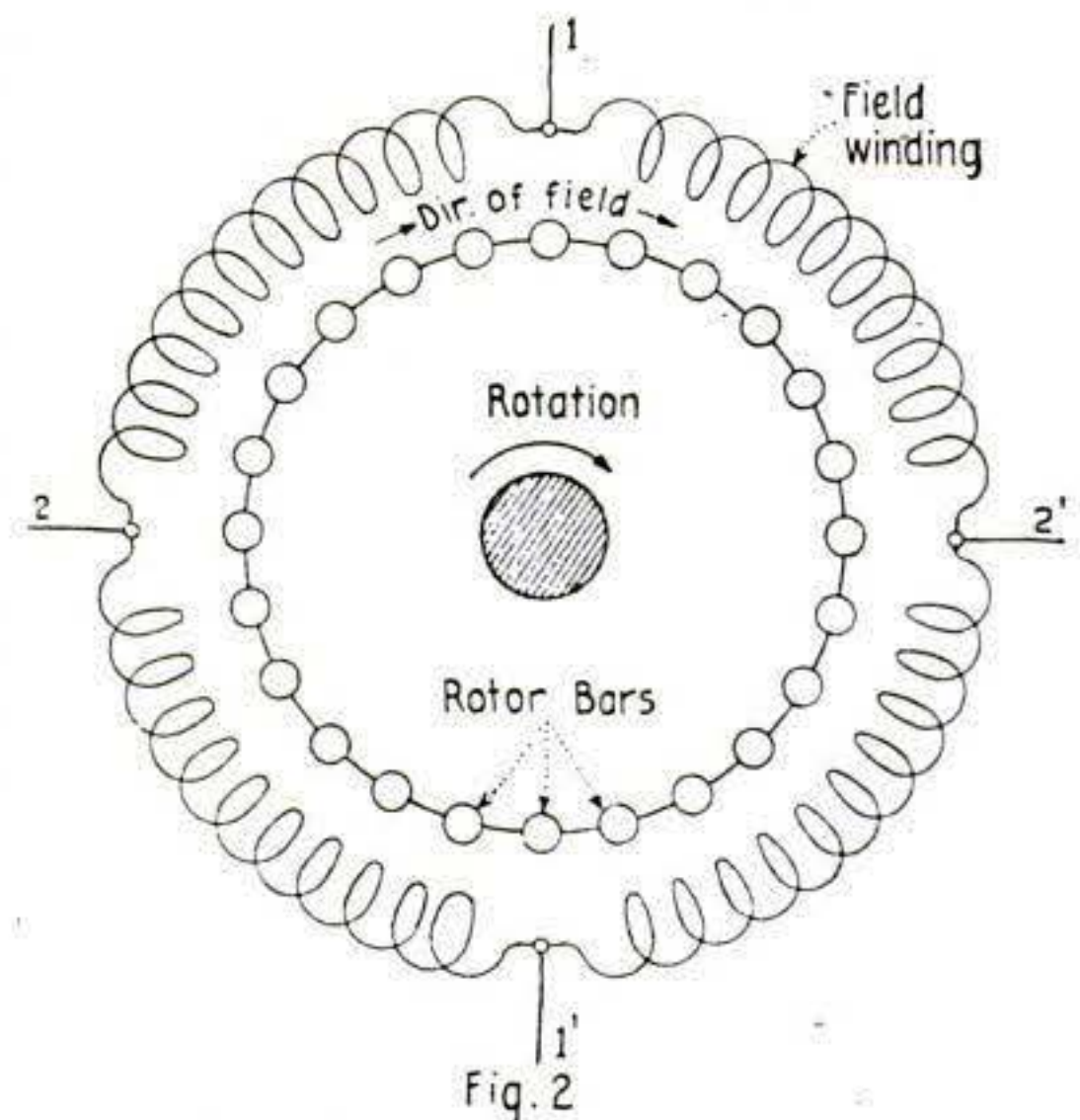


Two similar coils, through which two-phase currents are passed, are placed with axes at right angles to each other

flows through the motor in a positive direction, there exists a certain attraction between those electrical poles set up by the field current and those set up by current in the armature coils. Reversing the direction of flow of current causes these sets of poles to be reversed and the same attraction exists as previously.

In the foregoing discussion, however, a very important consideration has been disregarded. Every coil of wire wound on an iron core, as in the case of the field magnets, has an appreciable inductance, which, when an alternating current is applied, acts as a resistance component and tends to restrict the flow of current. It is mainly due to this fact that the majority of D.C. motors, especially the larger sized ones, cannot be operated on A.C. circuits. Thus, if a D.C. motor were constructed without iron in the fields or armature, it would operate on A.C. as well as on D.C. circuits.

There are two principal types of A.C. motors, namely, the synchronous motor and the induction motor. In the synchronous motor, the armature will not start of itself, but must be brought by some accessory motor to such a speed that the armature coils move from one field pole to the next in exact synchronism with the alternations of the impressed current. When brought up to synchronous speed, it will continue to do work when driven by a single-phase alternating current. The second type is the induction motor, in which a rotating



A combination of two coils at right angles for producing a rotating magnetic field

each other, as shown in Fig. 1. An alternating current in a coil without iron causes an alternating magnetic field along the axis of the coil. Thus, the two magnetic fields produced by the two-phase currents are similar to the two motions of the ball in the foregoing experiment, combining to produce a rotating field near their common center. This combination of two coils at right angles for producing a rotating magnetic field is suitable for

two-phase currents only. The winding arrangement of this form is shown diagrammatically in Fig. 2. A rotating magnetic field can also be produced by three-phase currents, differing in phase by 120 deg. or one third of a period, if the three coils composing the field are arranged as in Fig. 3.

The stator windings for polyphase

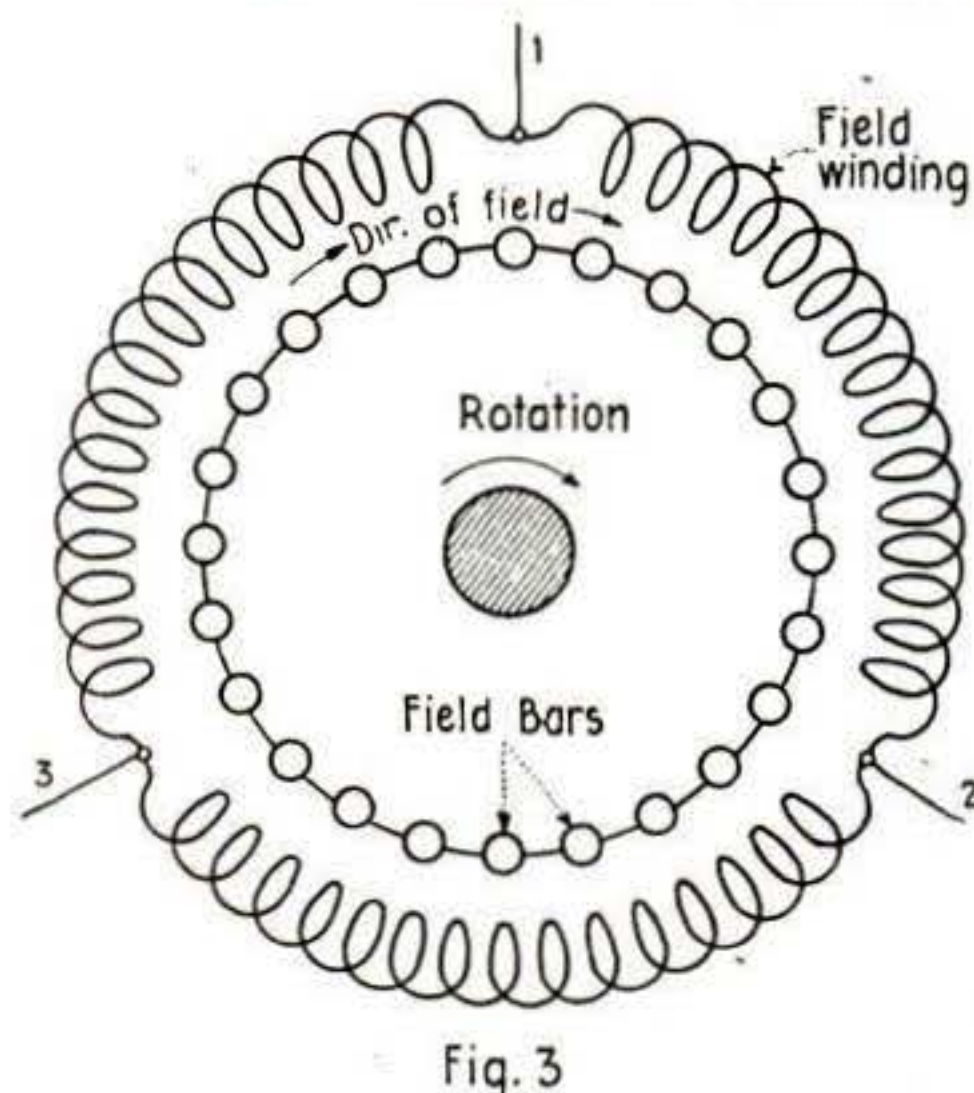


Fig. 3

A rotating magnetic field can be made by three-phase currents with this arrangement

currents may be arranged in several different ways. For two-phase systems, the windings are divided into four separate circuits, all having corresponding ends connected with a common junction, the other four ends being directly connected with the four line wires. In the three-phase system, windings may be Δ - or Y-connected. The triangle connection is shown in Fig. 3. For Y-connection the three circuits have a corresponding end of each connected with a common point, the other ends being attached to the three-line wires. Some connection diagrams are shown in Fig. 4 (page 136).

The polyphase motor always consists of two parts, the primary and secondary members. The primary member is usually stationary, and consists of a laminated frame slotted on its inner surface, in which slots the stator windings are placed. The stator windings, or primary coils, are connected as explained above, and the leads from the ends of the coils are brought out to a terminal board fastened to the side of the motor frame.

The secondary member consists of a laminated iron core with partially closed slots through the outer edge. Insulated copper bars inserted in these slots are bolted to copper rings on each end of the armature and are thus short-circuited. This is called the "squirrel-cage" type of armature, owing to its similarity to the ordinary squirrel cage. As the lines of force of the field rotate, they cut across the bars of the armature, inducing currents in them, which by Lenz's law are in such a direction as to check the induction in it, or, in other words, to resist the relative motion of armature and field. The armature is therefore dragged around in the direction in which the magnetic field rotates. The

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rotor tends to rotate as fast as the field, but never quite reaches it, for there would be no cutting of lines of force and thence no induction. This difference in the relative speeds of field and armature is termed the "slip." If the load is too heavy the motor will come to rest and burn out.

In the foregoing discussion, it will have been noticed that the armature requires neither commutator nor slip-rings, and is entirely separate from any other circuit; its currents are wholly inductive. It will also be apparent that if, instead of a squirrel-cage rotor, there is provided a regular armature winding, the induced currents can be brought outside of the machine and be controlled by resistance like those of any dynamo or motor armature. This scheme is often made use of in large motors, where the armature coils are connected with slip-rings, so that resistance may be inserted in the circuits at starting. This resistance is cut out as the motor gets up to speed.

The rotor of an induction motor acts like the secondary of a transformer, and if it is at rest while currents are traversing the stator the effect is the same as though a transformer were short-circuited. For this reason, these motors require enormous starting current, in value sometimes five or six times the running current.

In some types of induction motor, the field is made the revolving element, whereas the armature winding is placed on the stationary part of the machine.

The operating conditions remain the same whether armature or field revolves; but certain peculiarities in the design of the larger size motors, especially, make it preferable to have the field revolve.

The term "field" and "armature" have a rather indefinite meaning when applied to A.C. motors. The field is that element which receives current from the line, while the armature is that element in which current is induced. The more common designation is "rotor" for the revolving element and "stator" for the stationary element, although owing to their similarity to transformers the field is sometimes termed the primary element and the armature the secondary element.

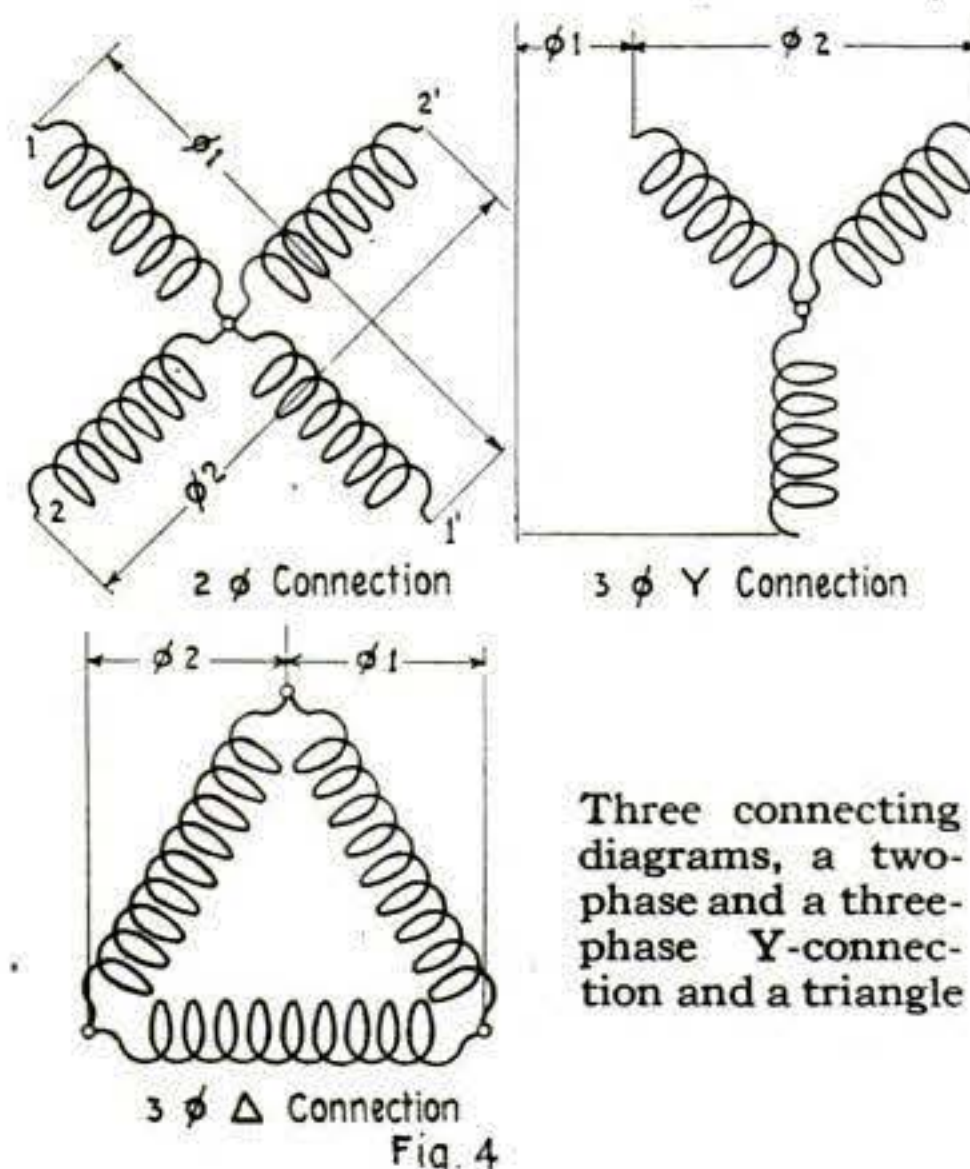
The great simplicity of the squirrel-cage induction motor, its durability and ready adaptation to any constant speed device, have made a place for it, especially the smaller sized ones, that cannot be disputed by the synchronous motor, but in the larger sizes the latter type can be used to advantage in many cases.

If the field excitation of a synchronous motor is varied the power factor is also altered and it is possible by varying the exciting current to produce a leading current, thus causing the motor to have the same effect on the line as would be caused by a condenser. This characteristic is some-

times taken advantage of to increase the power factor on lines where it is low.

From a mechanical standpoint there is no question but that the induction motor, with its absence of sliding contacts, and its simply constructed rotor, lends itself to more severe service than the synchronous motor with its more complicated rotating member.

From an electrical viewpoint the induction has the advantage of simplicity, very little auxiliary apparatus being required for its operation, and little attendance being necessary after the machine is once started, as no skill of the operator can change its oper-



ating characteristics as long as the load is not in excess of the motor's capacity. The synchronous motor, on the other hand, must have a separate direct-current exciter or other source of excitation, with rheostats, field switches, etc., and good operation depends largely upon the degree of field excitation given the motor.

The induction motor operates at a constant lagging power-factor: the lighter the load the greater the lag. The power-factor of the synchronous motor is within control and can be varied by the manipulation of the field rheostat.

The starting characteristics of both types are nearly the same, either machine taking a heavy lagging current from the line when started under load. The starting apparatus is very similar in either case, with the additional slight complication caused by the field of the synchronous motor, it being necessary to open up the field when starting, and put it on again when the machine has come up to synchronous speed.

In view of the foregoing it is obvious that each type of motor has its individual advantages. It is useful to bear in mind the consideration that induction motors are poor and expensive at low speeds, while they are satisfactory and comparatively cheap at high speed. Hence the lower the required speed the greater the justification for using a synchronous instead of an induction motor.

There are localities where only single-phase currents are available. Under such conditions, the single-phase induction motor must be used, also in the smaller sizes, as it has advantages over polyphase types. It requires but two wires and one transformer, thus reducing the expense of wiring and transformers considerably.

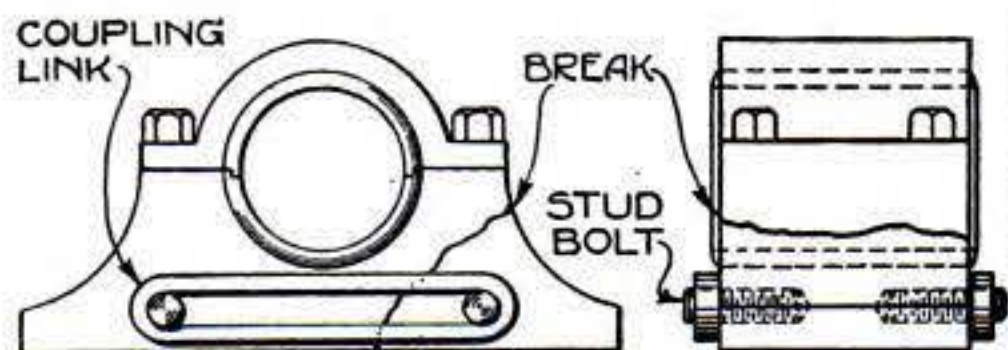
Single-phase motors differ from poly-phase induction motors in their method of starting, but when brought up to speed their action is the same. The stator is similar to that of a three-phase motor, and the rotor is usually of the squirrel-cage type or a modification of this, although it may be of the wound-rotor type.

Single-phase induction motors possess no starting torque. In some cases an external starting-box is employed to secure the necessary phase difference in the current. This is done to set up an imperfect rotating field, sufficient to bring the motor up to speed under light load, after which the starting winding is usually cut out.

There are several methods by which the speeds of induction motors may be varied. These are briefly: Varying the frequency; changing the number of poles; varying the rotor resistance; using two or more motors in parallel; and varying the applied voltage. Of all these methods, only two are commonly used in ordinary motor applications. These are: changing the number of poles and varying the rotor resistance. The others are applicable only in very special cases.

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Shrinking a link on pins to hold a broken part to a large pillow block

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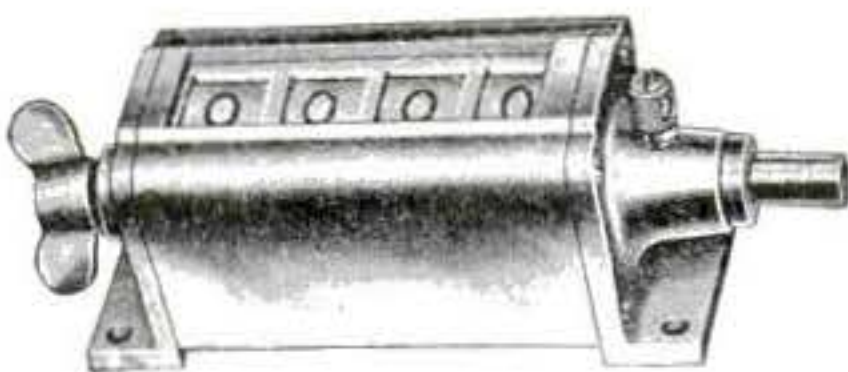
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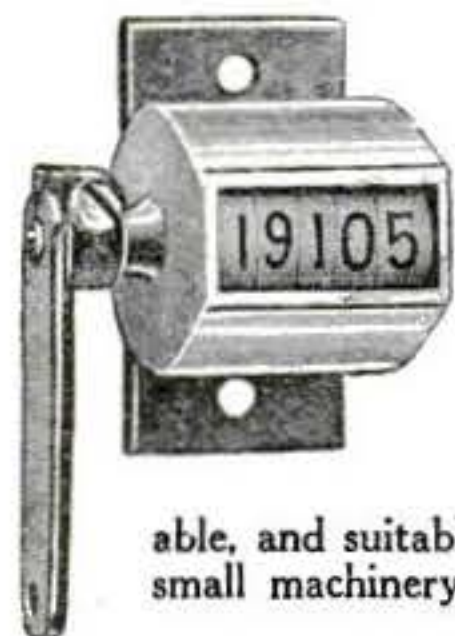
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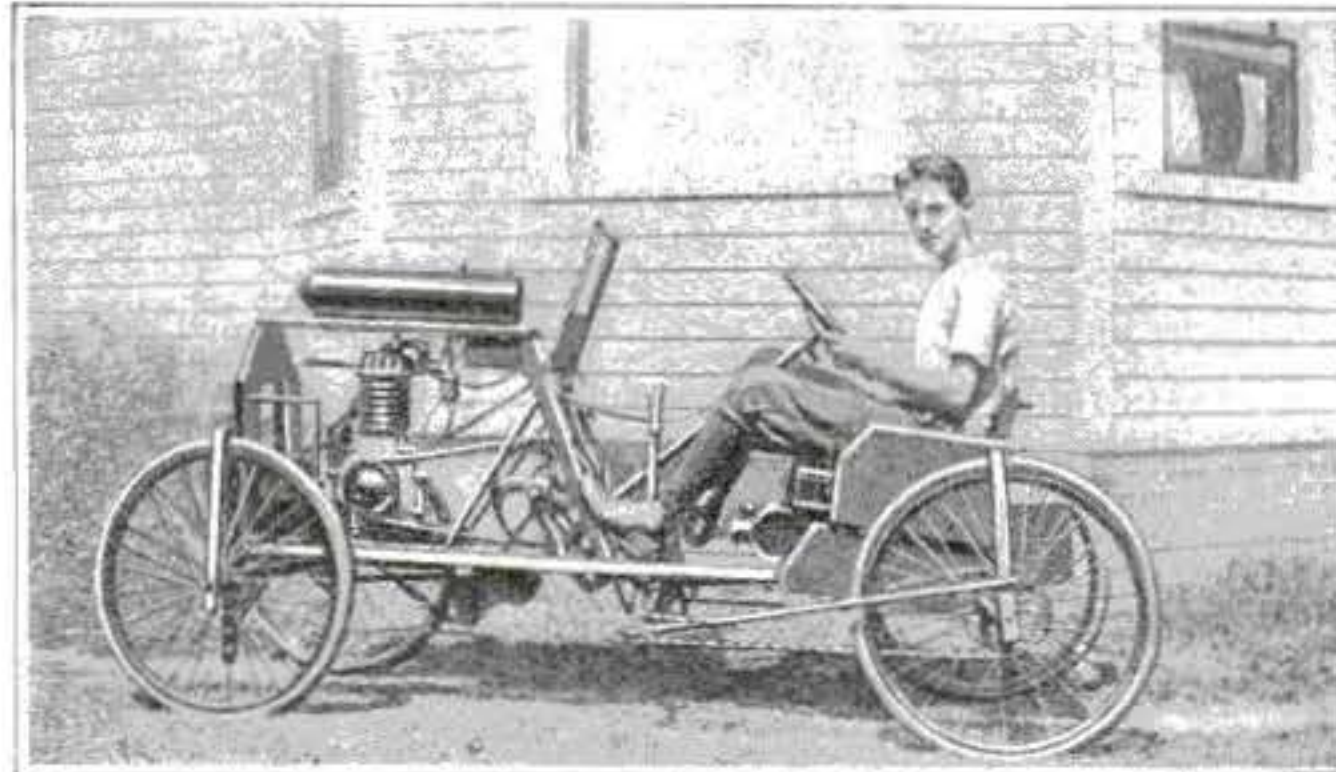


A counter for almost every machine will be found in the Veeder booklet—may we send you a copy?

The Veeder Mfg. Co.
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A Small Car Made of Bicycle Parts and a Motorcycle Engine

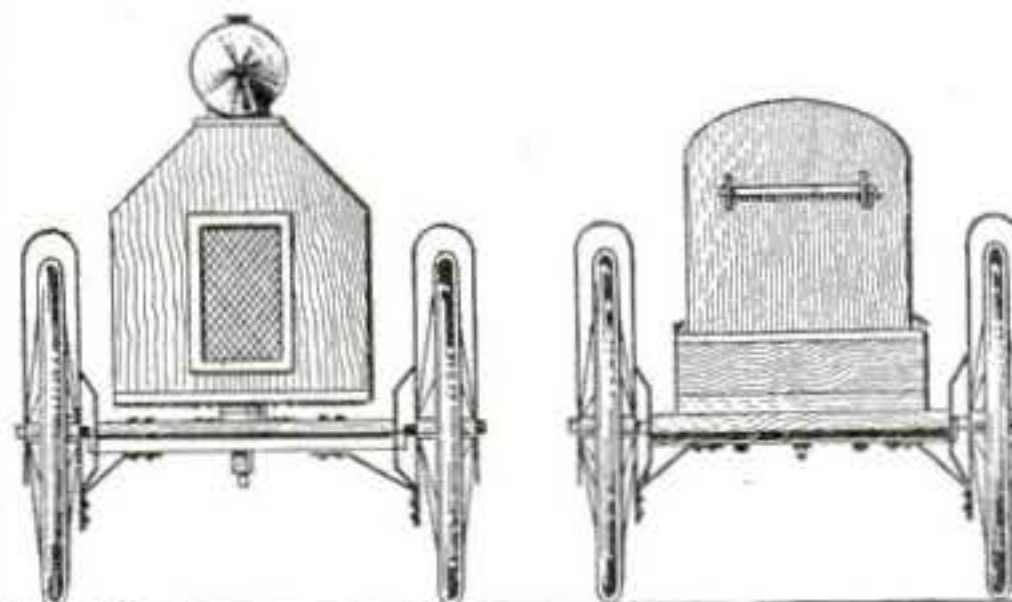
THE wheels, sprockets, chains, etc., which were used in making this car were taken from old discarded bicycles. The four-horsepower, four-cycle engine was procured from an old motorcycle. A small pulley was fastened to the engine shaft and connected with a larger pulley on the counter-shaft, by means of a slack belt. This belt may be tightened by swinging an idler pulley, which is operated by a lever at the driver's seat. When the idler pulley is released from the belt, the engine will run at full speed, without moving the car. A pull on the



A four-horsepower motorcycle engine drives this car

lever will bring the idler pulley down on the belt, tightening it, and the bicycle chain from the counter-shaft pulley to the rear drive sprocket will revolve, thereby making the car move. The more pressure placed on the belt by the swinging idler pulley, the faster the car will go. As coaster hubs are used on the rear wheels, it is not necessary to have a differential.

The frame of the car is made of 1-in.



Front and rear end elevation showing axle construction for using bicycle wheels

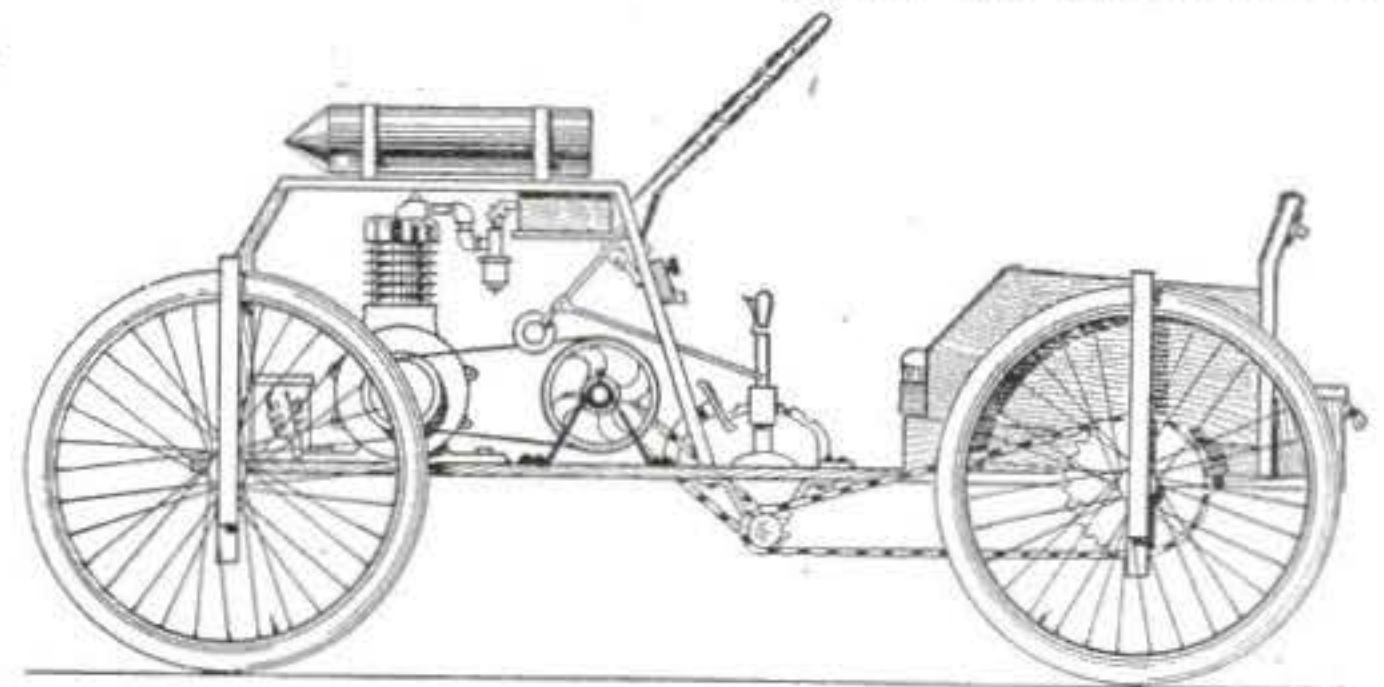
oak, which gives a spring when the wheels pass over a bump. The seat is made of the same material and has a leather cushion. The cushion, as well as the steering gear and other small attachments, were purchased from a dealer in second-hand automobile supplies.

An isinglass windshield protects the driver's face and permits a clear view ahead. In the back part of the car is a tool-chest for carrying the necessary tools.—NORMAN E. KLIPP.

A Method of Computing the Resistance of Copper Wire

RESISTANCES of copper wire of the Brown and Sharp gage may be computed approximately with the following data. The calculations are based upon the fact that the resistance of 1,000 ft. of No. 10 wire is approximately 1 ohm at 20 deg. C. Since the diameter by the B. and S. gage doubles or halves every six numbers, and therefore, the areas double or halve every three numbers, it obviously follows that for every third number of smaller wire, the resistance doubles, and for every third number of larger wire the resistance is halved. Thus No. 13 wire has a resistance of 2 ohms per 1,000 ft., No. 16 a resistance of 4 ohms, No. 4 a resistance of 0.25 ohms, all at the temperature above mentioned.

Using the same gage, the cross-section of consecutive numbers increases by 26 per cent. Let us say it is desired to find the resistance of No. 8 copper wire. Since the resistance of



Side elevation showing the relative positions of the engine, counter-shaft, control levers, and chain drive

No. 7 per 1,000 ft. is 0.5 ohms, that of No. 8 will be 0.63 ohms. The largest size in the wire table is No. 0000 with 211,600 circular mills. The size decreases with the increase of the wire number, No. 10 wire having approximately a diameter of 0.1 in. and 10,000 circular mills.—HERMAN NEUHAUS.

Winners of the "Helping Out the Farmer" Prize Contest

Out of the large number of interesting articles describing devices to lessen the labor on the farm, the three subjects below were selected by the judges for the grand prizes:

First Prize—A Drainage and Irrigating Pump. By Sebastian Vierengel.

Second Prize—A Sling Reel for the Hay-Rack. By Alfred J. Kahler.

Third Prize—A Small Follow-Up Harrow Attached to a Plow. By A. A. Jeffrey.

These three articles will appear in the November issue of POPULAR SCIENCE MONTHLY.

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How the Velocity of Rifle Bullets Is Tested

THE chronograph is an instrument for testing the initial, or muzzle, velocity of bullets, and hence of the charge that is put in the cartridge. The illustration shows how the test is made and gives an idea of how the chronograph works. In the drawing the instrument is shown simplified and the parts are somewhat displaced to make illustrating clearer.

The rifle in which the test is to be made is rigidly held in a fixture that brings the line of fire accurately on two points spaced 180 ft. apart. Through one of these points a wire, A, is stretched, and through the other the wire, B, the former being directly in front of the muzzle of the rifle. Both of these wires are cut when the gun is fired. Wire B passes through the target. Each wire is part of a separate electric circuit and the discharge of the rifle breaks both circuits, one a fraction later than the other.

Mounted elsewhere on a solid foundation is the chronograph which con-

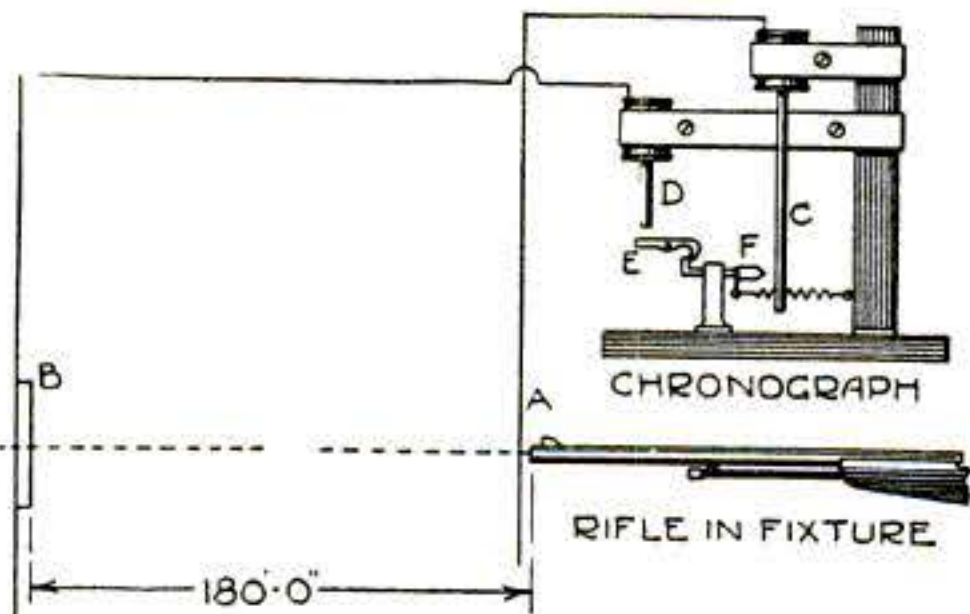


Diagram showing the positions of the instrument and electrical connections to determine the speed of a bullet

sists of a base, a column suspending two electro magnets, and a recording mechanism. Each magnet at rest holds a brass rod by the end, the end having a cap of steel for purposes of attraction. The winding of one magnet is connected to the wire B, and of the other to the wire A, which is ahead of the muzzle. It can be readily seen that the bullet in its flight breaks both circuits and causes both rods to fall. The rod C is longer and heavier than its fellow and its circuit is first broken; it has traveled some distance before the recording mechanism acts; this makes for accurate results.

When the rod D falls it hits a trigger catch, E, that releases an arm, F, under spring tension and the knife edge, which is a part of the arm, flies forward and nicks the falling rod, C, in its path. Then the rods are returned to the magnets and by means of a switch for that purpose, both circuits are broken at the same time and the knife edge again nicks the rod C, but this time in a different place because the rod, C, did not get first start. By use of a scale it is possible to read directly the velocity of the bullet for 180 ft. All the work must be done with the greatest care and when so performed the results will be very close.—D. A. HAMPSON.



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Making a Phonograph from Erector Strips

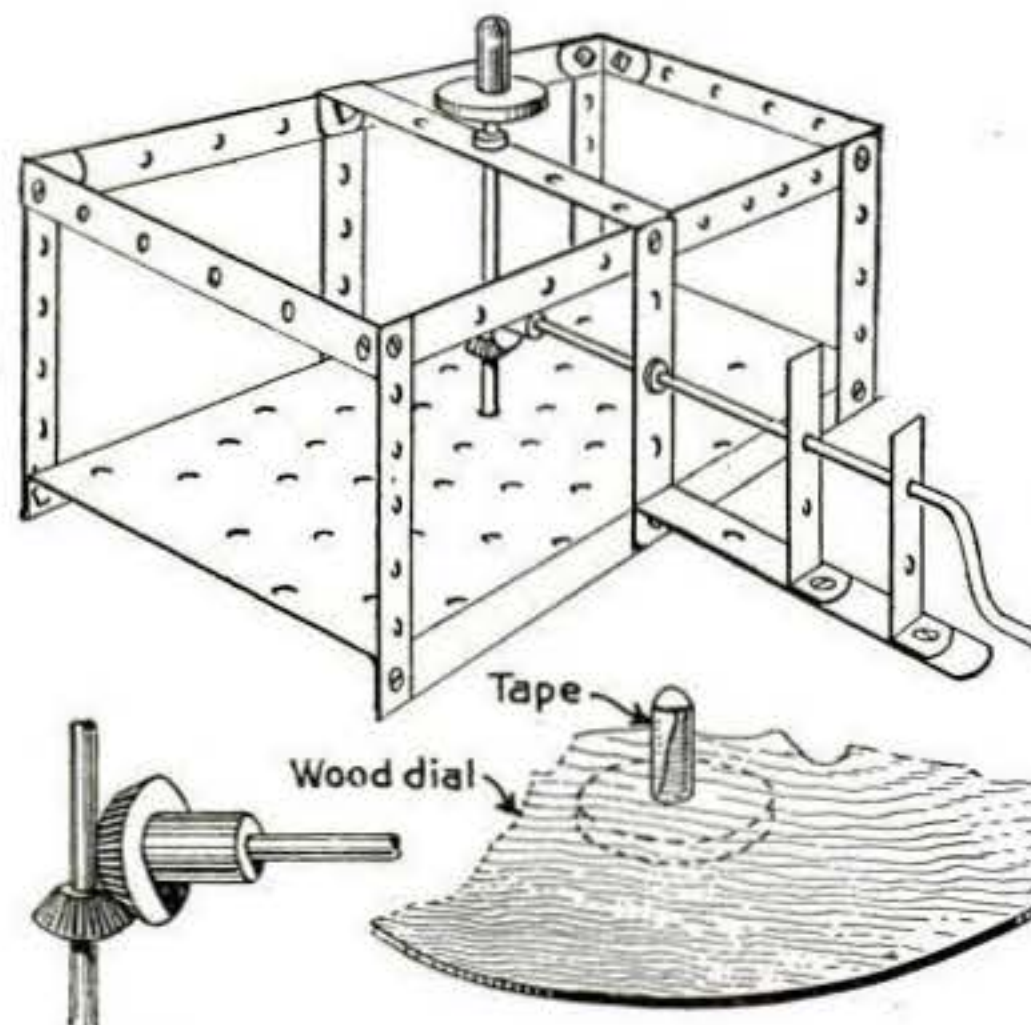
THE phonograph illustrated was made with a set of mechanical erector strips which happened to be at hand, but I am sure that a little ingenuity on the part of the builder would enable him to make a frame especially for the moving parts that would give better results. There are only two things that are absolutely essential to the good working of the phonograph; these are the rigidity of the machine and the fit between the needle and the paper.

The machine described was designed especially for rigidity. The extra pieces extending to the right and holding the crank, were put there to minimize vibration. All the points of contact of the rods with the perforated pieces must be kept thoroughly oiled to prevent their wearing and rattling. A little oil usually stops the grinding of the gears. The top of the wooden dial is covered with felt, and the rod above it is wrapped with tape until a tight fit is secured with the record.

The horn is best made of parchment, but stiff wrapping-paper answers the purpose. It should not be rolled with too wide a mouth or it will be flabby. It is glued wherever necessary and the small end is bent over and also glued so that the whole is fairly rigid and makes a good sound board. A phonograph needle thrust through the paper completes the sound box. It will be found that after playing records for some time the sound will become weaker. This is caused by the needle working loose and can be remedied by putting the needle in a new hole.

The phonograph will reproduce instrumental selections very well, but its motion is not steadied enough by the record to play sustained notes. The smoothest motion can be obtained by sitting so that the forearm only need be moved when turning the crank. A spool of thread on the end of the crank also makes for smoothness.

The apparatus is screwed down to a board so that one need not worry about anything except turning the crank as steadily as possible.—E. D. RIES.



The erector parts as they are joined to make the driving mechanism for turning the disk

A Compound that Will Clean and Polish Brass

HERE is a brass polish that cannot be excelled. It requires very little effort, and will clean and bring to a high luster the dirtiest and most tarnished pieces.

Take 5 oz. silica, 1 oz. whiting, and 1 oz. of finely powdered oxalic acid, and mix thoroughly. Next, shave up 1 oz.

or more of laundry soap, add a little water, and melt over a fire. Then mix the whole thing together, using water to thin if necessary. When sufficiently mixed, pour into a tin cover or other receptacle and allow it to set into a cake.

To use, wet a cloth and rub it on the cake, and proceed to clean the brass. Then finish off with a clean, dry flannel

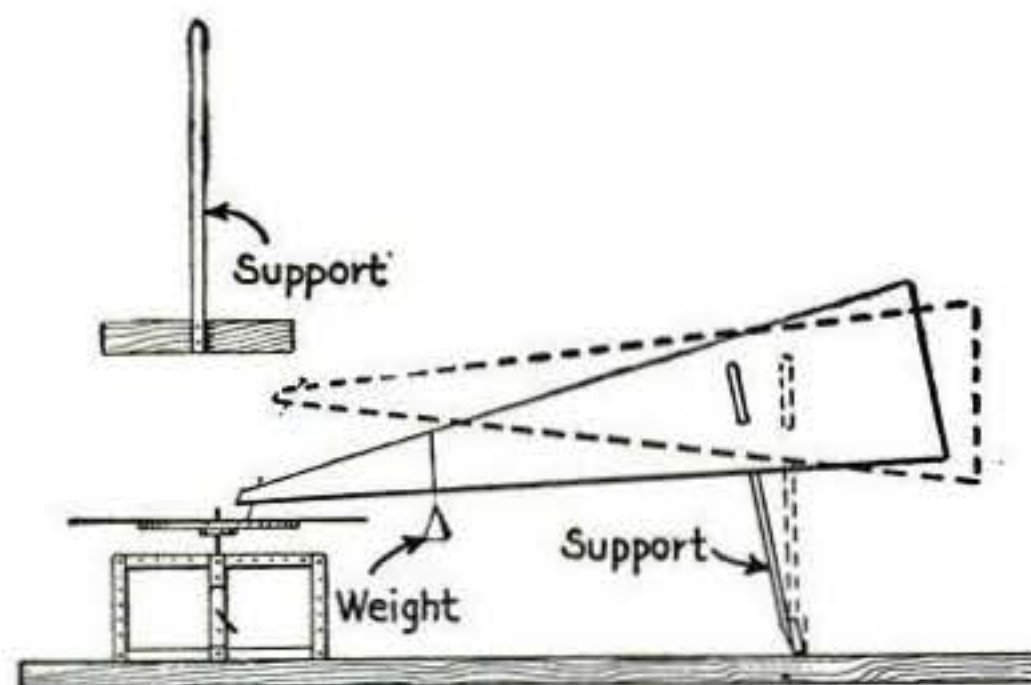
or a piece of chamois.

Most formulas for brass polish use rotten stone, which is very dirty to handle. Silica is much better, giving a much nicer gloss and is a great deal cleaner to use.

Proper Method of Using a Small Tap to Prevent Breakage

NO one knows how many thousands of small taps are broken every week by mechanics, both amateur and professional, who do not know the trick of backing out a tap to clear it in a deep hole.

When a tap begins to get so tight that it does not seem safe to force it any further, it should be turned the opposite way, and this turning should be continued until the tap can be felt to catch slightly and then loosen up again. The amount of the turn will be about equal to



How the horn is mounted on the base so that it will follow the grooves in the disk record

the distance between the cutting faces of the tap—that is, a third of a turn if there are three cutting faces. When the tap is backed the little cuttings sticking up are broken off, so that when the tap is started in again it does not have to break off its own shavings at the same time that they are being cut. If the tap is simply backed a little without going far enough to do this there will be almost as much danger of breakage as if it were not backed at all.



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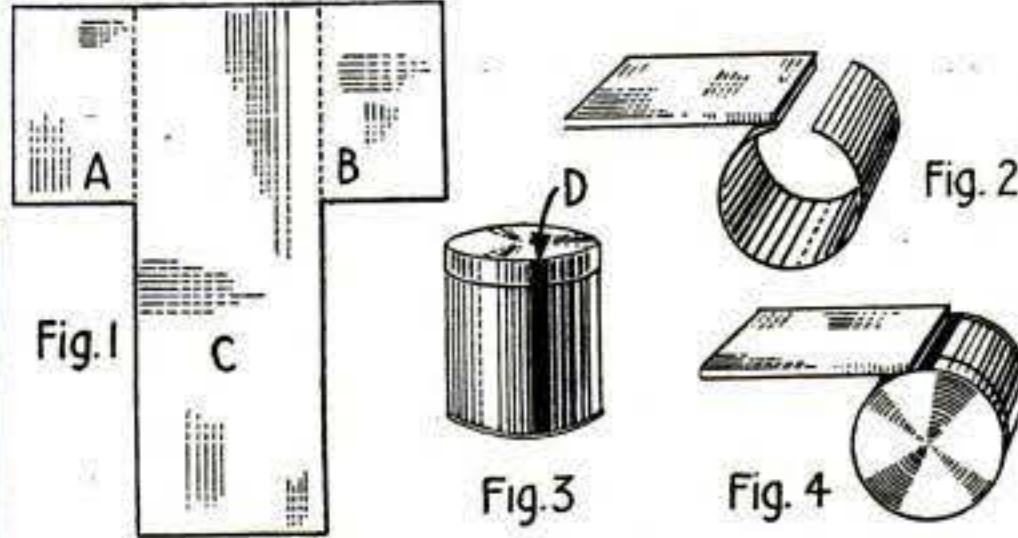
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A Whistle Made from a Baking-Powder Can

METAL whistles are much better than those made of hickory or willow, but the average boy thinks that the metal is hard to handle; this, however, is not so, as such a whistle can be made easily from a baking-powder can as shown in the illustration. Cut from a tin fruit can a piece of the metal as shown in Fig. 1



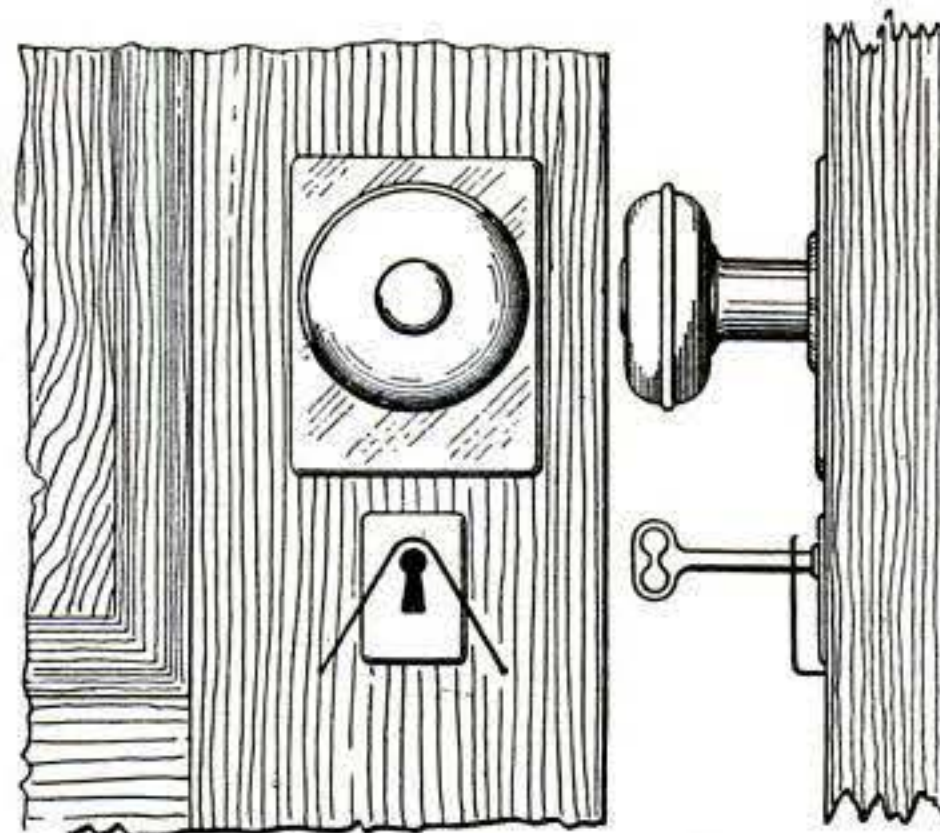
Pattern for cutting the metal around a baking-powder can for making a whistle

and bend the ends A and B over a piece of strap iron or a thick piece of sheet metal, and the end C into a curve as shown in Fig. 2.

Cut down a small baking-powder can to a length equal to the width of the whistle or the part C. Cut a slit in the can at D (Fig. 3) lengthwise and stick the circular part of Fig. 2 inside of the can so that the extending part C will enter the can at the bend next to the circular part. The correct angle of the part C can be found only by trial, and bending until the proper note is found. The finished whistle is shown in Fig. 4.—JOHN L. DOUGHENY.

Wire Guide Around the Keyhole to Prevent Profanity

IT is sometimes difficult because of poor light to slip a door key into the keyhole. In the dark it is an exasperating proposition even after one has located the knob. The illustration shows how a piece of wire can be bent and driven in the wood around the hole plate, so that the key can be



A wire hook shaped around the keyhole to guide the key for entering the escutcheon

readily lined with and entered into the hole. The taper of the wire of course drifts the key into place and it can be carried no further. This little kink will be found a saver of temper and a great convenience.—F. W. BENTLEY.

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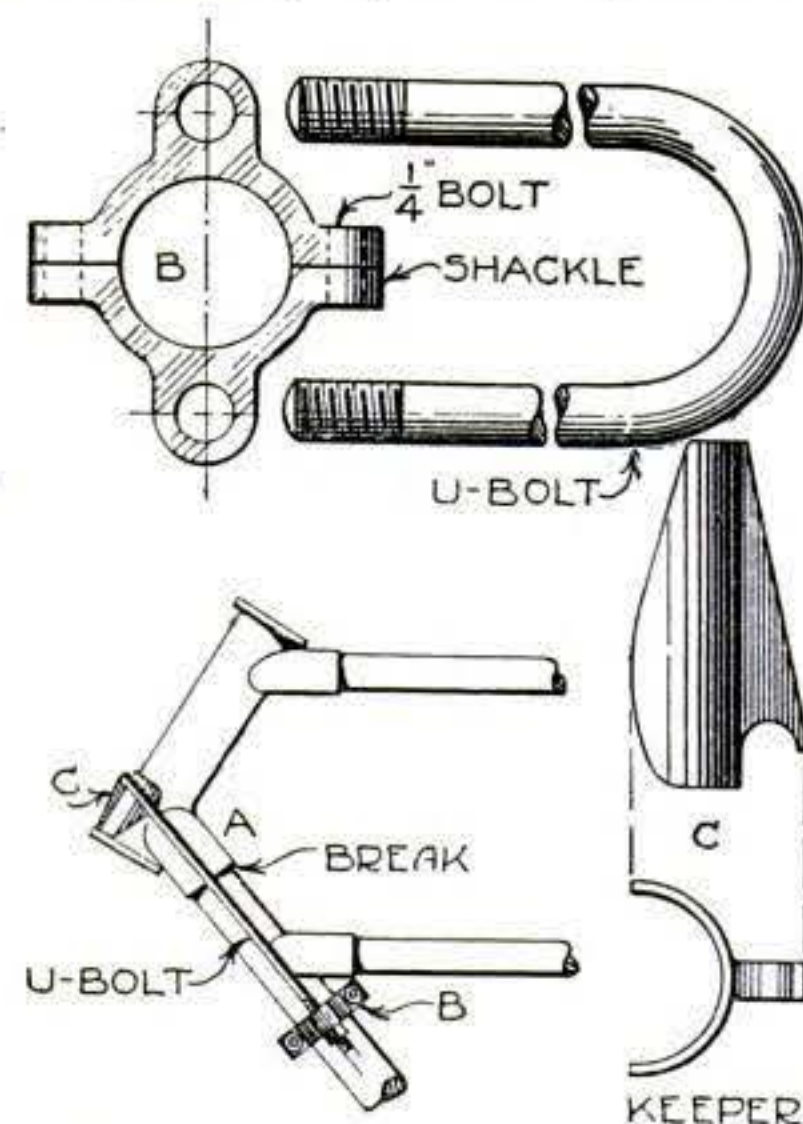
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Repairing a Broken Motorcycle Frame Without Brazing

A BREAK in the frame at A was repaired with a U-bolt in the manner shown. The entire device was homemade with the exception of the two nuts.

The shackle, B, was shaped from a



A method of joining broken parts of a motorcycle frame without brazing the joints

piece of metal in halves so that it could be adjusted over the frame tube. The keeper, C, was made from a felloe strap.

This device when clamped in place held the frame tube to the headpiece so close that the break could not be detected.

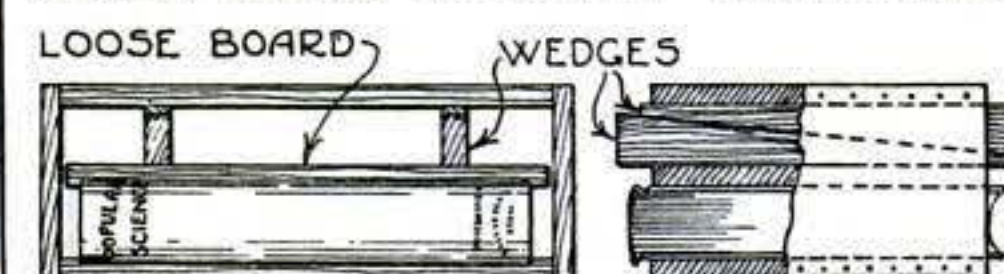
The whole appearance of the device gives the impression of being an original attachment.—W. H. SARGEANT.

Making a Press to Shape Books After Rebinding

A SIMPLE book press which can also be used for other purposes can be made in the following simple manner:

Out of a good, straight-grained piece of 1 by 6-in. pine saw three pieces 12 in. long and two pieces 8 in. long. Nail the two short pieces on the ends of two of the long pieces, forming an open frame, as shown in the illustration.

The remaining 12 in. piece should fit loosely within the frame. Then make



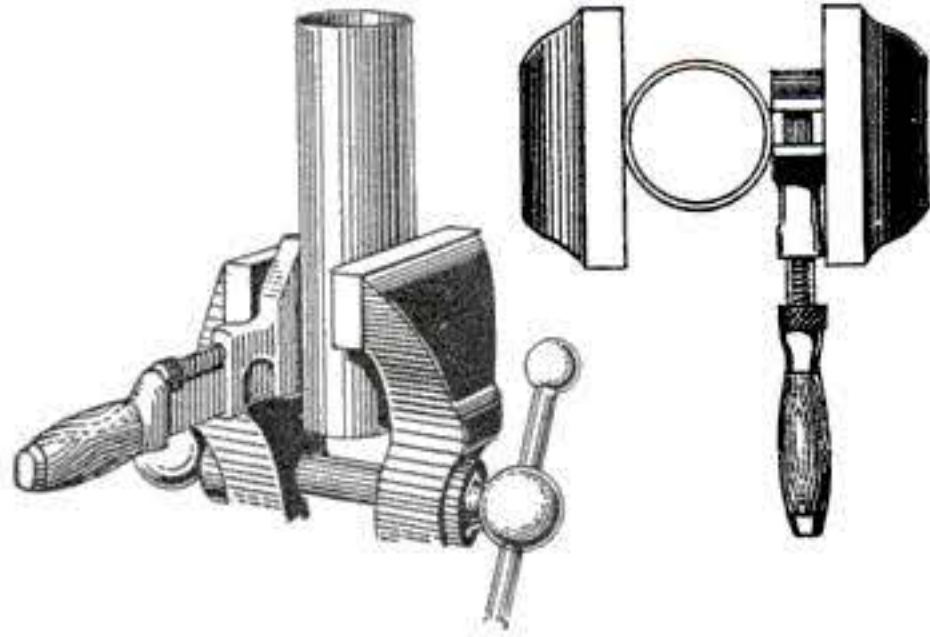
A wood frame and the manner of using it with wedges to make a book-press

a half dozen or more wedges by sawing diagonally across several oblong blocks of 1-in. stuff.

By keeping each pair of wedges together a more perfect fit can be obtained, as some of the blocks may be cut at slightly different angles than others. The illustration shows the press as it is used to shape a book after rebinding it.

A Monkey-Wrench Placed in a Vise to Hold Pipe

THE illustration shows how the placing of a monkey-wrench in the ordinary vise makes it possible



An ingenious use of two implements that are found in every tool-box

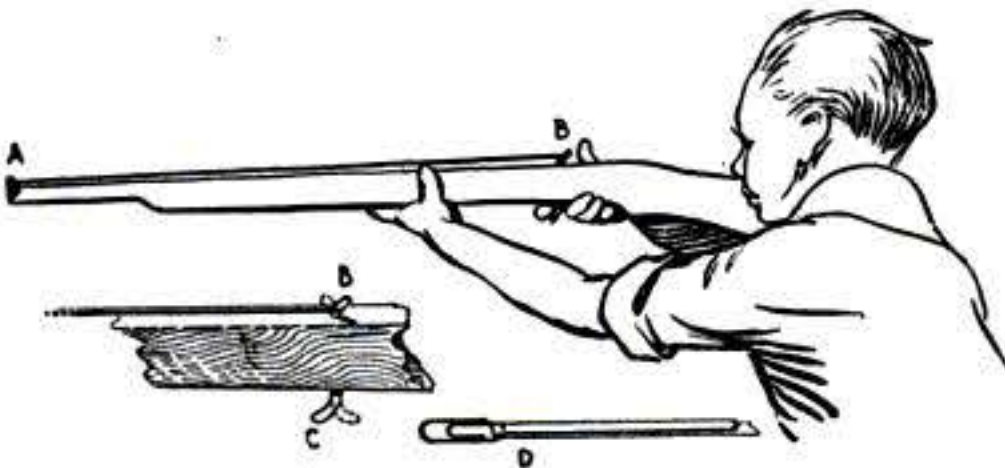
to hold a pipe for cutting threads or turning on fittings. As both wrench and vise are adjustable, quite a wide range of sizes can be handled in this manner.—VINCENT J. MCMURTRY.

A Coating to Keep Silver from Tarnishing

SILVERWARE may be easily prevented from tarnishing, if it is brushed over carefully with alcohol in which a little collodion has been dissolved. The coating dries almost immediately, leaving a thin, transparent and invisible surface on the silver. This surface may be removed at any time by simply dipping the article in hot water.

A Straight Shooting Rubber-Band Gun for Boys

THIS homemade shooter is a marvel in its simplicity. The stock and barrel are made of any wood easily carved to the desired size and shape, and the length is proportioned by the elasticity of the rubber bands employed as ammunition. At the sight A a small groove is cut and from this the rubber is stretched back to and hooked over the trigger B. The trigger is of bent wire formed with



Details of the parts and how the gun is used to shoot ordinary rubber bands

the ends facing opposite directions after the wire is forced through a hole of the same size bored through the barrel at its position. A simple turn of the trigger finger C frees the rubber for its straight-away flight. If an ordinary paper hook is attached to the rubber as shown at D the flight is much longer and considerable range is acquired. Like action may be had in pistol design also. The slight sting of a "wound" from one of these weapons only adds spice to a close battle among the boys.—W. B. SMITH.



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AT this time, the conservation of your Disston Saws and Tools is important. It is as important as the conservation of foods and other products. We ask that all mechanics take the best possible care of their Disston Hand-Saws. Get every dollar of value out of them that Disston quality has put into them.

Keep them properly filed and set. Use a Disston Slim Taper File and a Disston Triumph Saw-Set. These first-class tools, used every little while, will save the time and energy you'd need to put a neglected saw back into good condition. Don't use a poorly made saw-set. If you do, you'll risk crimping the blade or breaking the teeth. That means shortening the life of your saw by excessive pointing to get back the teeth. You can get the Disston Slim Taper File and Triumph Saw-Set from a hardware dealer in your vicinity.

Keep your saws clean and free from rust by using a little oil and a piece of emery-cloth. Rust is apt to produce friction and make your saw bind or buckle—and a kinked saw is useless.

Amateurs, especially, will find that Disston Saws and Tools will help exercise the spirit of conservation. Their high grade, their accuracy, their quick response, even in the hands of the untrained, conduce to good work and a saving of money in the home.

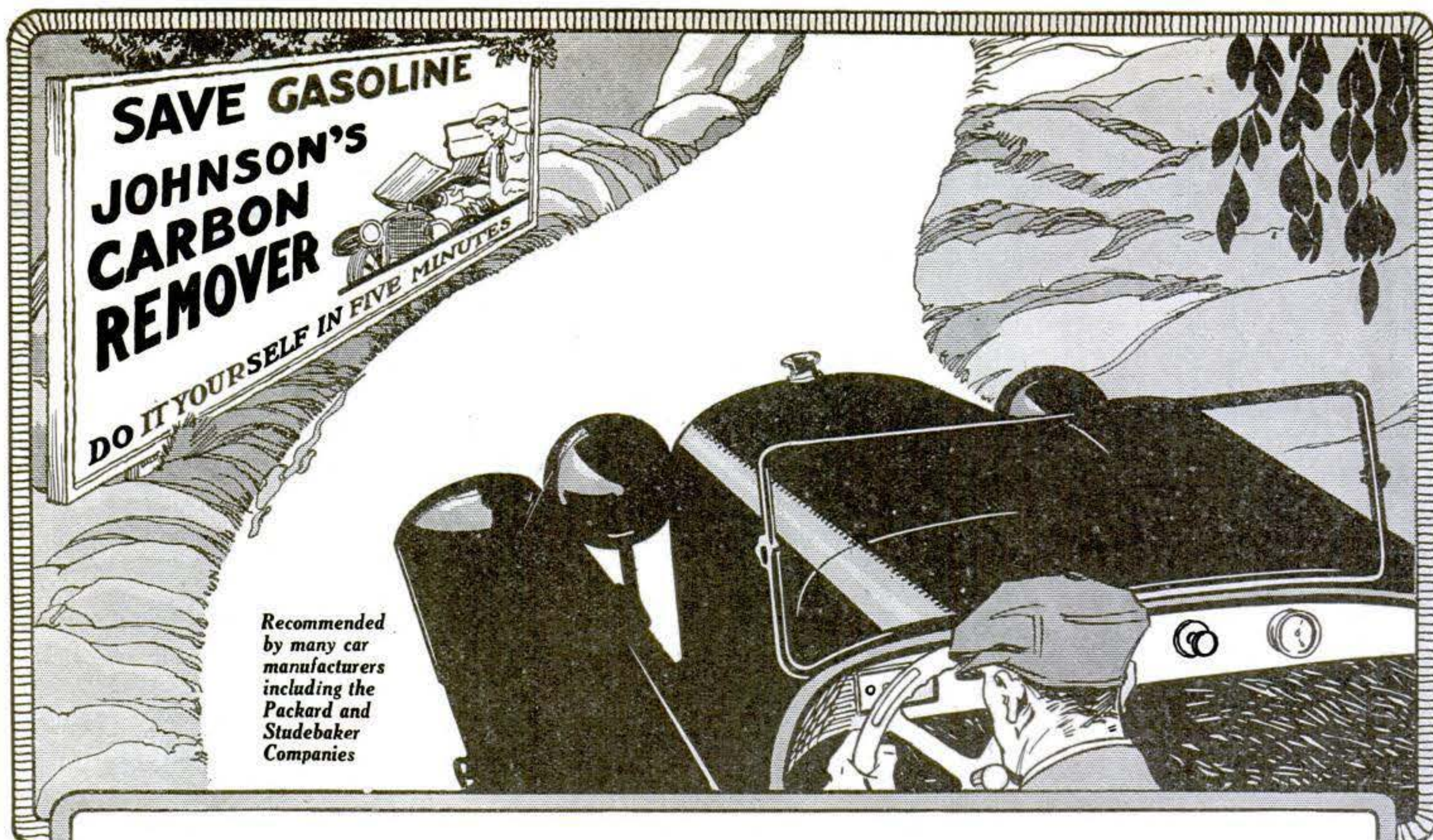
Henry Disston & Sons are the largest and oldest saw makers in the United States. Disston Saws are the expression of an experience of seventy-eight years. We are so bent on producing the finest in saws and tools that we make every ounce of the Crucible Steel that goes into every piece of merchandise bearing the Disston trademark. Disston quality means the best that human will and skill can put into tools. It is jealously guarded and rigidly maintained. Disston Saws and Tools are sold by progressive hardware dealers the world over.

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